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NEWS**

Founded
1896

Chicago, September 13, 1930

Issued Every Other Week

Volume XXXIII, No. 19

ARCOFRAX
HIGH ALUMINA BRICK

THROUGHOUT THE WORLD
GENERAL REFRACTORIES
PRODUCTS ARE GIVING THAT
EXTRA MEASURE OF SERVICE
TO CEMENT AND LIME
KILN OPERATORS

GREFCO
Chrome High Temperature Cement

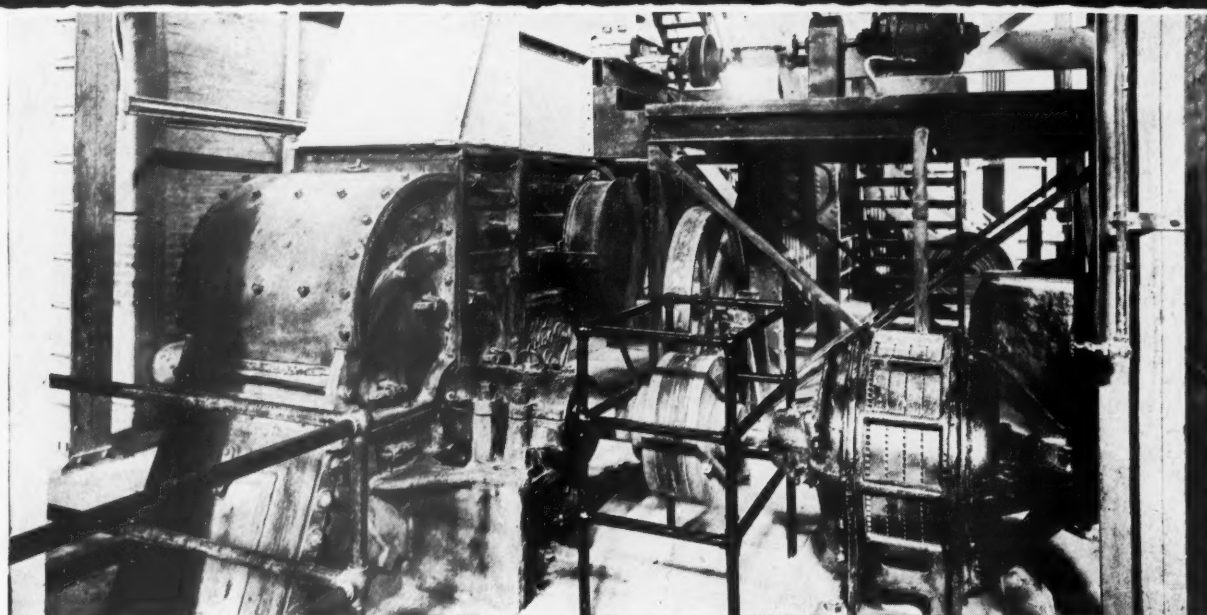
GENERAL REFRACTORIES COMPANY
106 South 16 St., PHILADELPHIA, PA.

A large circular graphic containing the text "THROUGHOUT THE WORLD GENERAL REFRACTORIES PRODUCTS ARE GIVING THAT EXTRA MEASURE OF SERVICE TO CEMENT AND LIME KILN OPERATORS" is the central focus. Above it, three boxes of ARCOFRAX bricks are shown. Below it, a bag of GREFCO cement is displayed. The background features a collage of industrial images, including a factory with smoking chimneys, a large industrial building, and a ship. A circular stamp on the right side of the advertisement reads "TRANSPORTATION LIBRARY" and "OF MICHIGAN".

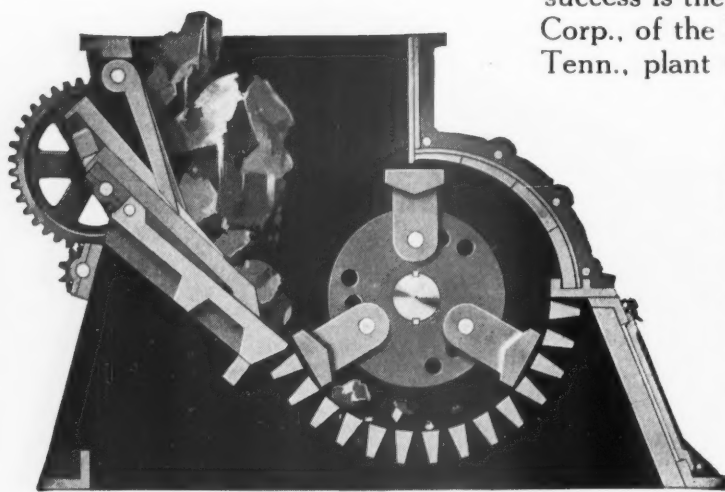
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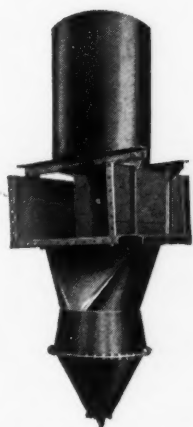
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Aboard a Lake-Going Sand and Gravel Plant

Not Merely a Description of a Novel Ship But a Narrative of Every-Day Life on Board the Marine Dredge and Gravel Co.'s Dredge and Floating Screening Plant, the "Brazil"

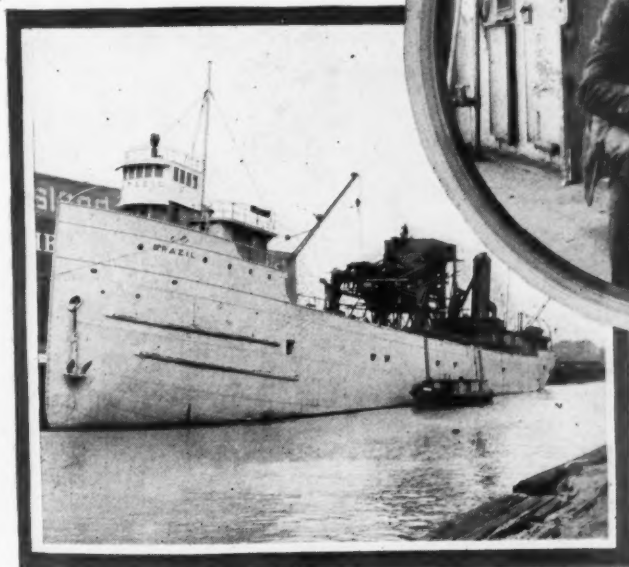
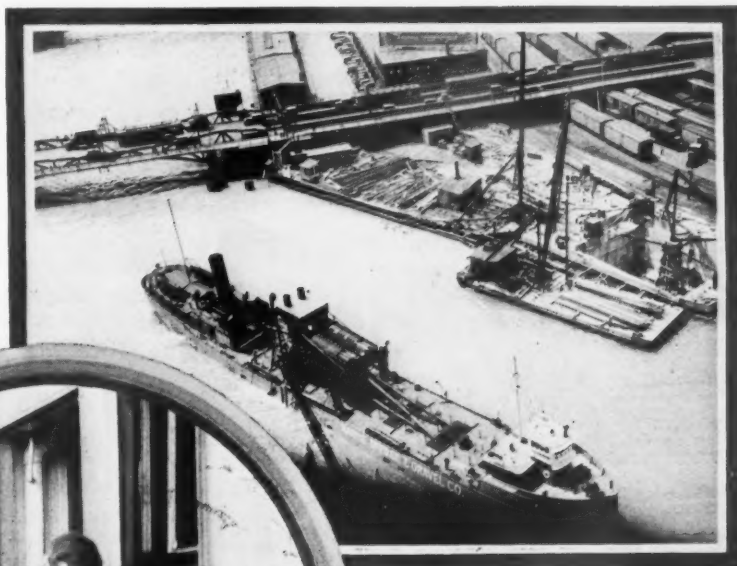
By Edmund Shaw

Contributing Editor, Rock Products

WHEN I spoke to Mr. Rockwood about writing a story on the sand and gravel boat *Brazil*, he suggested that it might be an interesting novelty if it were put in narrative form rather than that of the usual plant description.

Very well then. The reader is hereby invited to come aboard the *Brazil* as she is leaving No. 3 yard, just south of the Illinois Steel Co. works in South Chicago. It is evening and the deck is illuminated with floodlights and hanging bulbs. Looking down on it from the forward deck house it looks to be a confusion of valve wheels, hydraulic valve pipes and sand and gravel chutes with the screening and washing plant for a background. Aft of this may be seen the smoke stack (out of which no smoke must be permitted to escape while the boat is at the dock) and a pipe from

Dredge and screening plant, S. S. *Brazil*, in the Chicago river



Above, making screen tests. At the left, view of the *Brazil* at her dock in South Chicago, observing the "no smoking" rule

the condenser from which a lazy jet of steam issues. Men are moving about the deck putting things in order after the work of discharging. A hoarse whistle says, "Done with the pumps," lines are cast off, and the boat heads out for the revolving red light that marks the end of the breakwater.

The *Brazil* belongs to the Marine Dredge and Gravel Co. of Chicago and was formerly one of the big fleet of "sand suckers" that dig sand mostly for placing along Chicago's water front to make new park land. Last year she was tried experimentally in the production of gravel for concrete aggregate. The product found a ready sale and prospecting developed that there were probably beds of "torpedo" sand ("Chicagoeese" for sand that can be used for

concrete) and gravel from 1½- to ¾-in., that would pay to work commercially. This year, 1930, the boat was given new washing and screening equipment and placed in steady production.

Description of the "Brazil"

Over-all the *Brazil* measures 297 ft. and has a beam of 41 ft. She draws 20 ft. when fully loaded. There are two deck houses. The forward one has the pilot house above, the captain's room and a guest room below, and sleeping quarters on the main deck level. The after house has the galley and dining room and the engineer's and steward's quarters. Below the deck under this are the main engine and the pumps and auxiliary machinery.

We will visit the pumps first. These are the same that were used for pumping fill sand, of Morris Machine Co.'s make with 18-in. suction and discharge pipes. Each is coupled to a Morris triple-expansion steam engine which can develop 500 hp., if it has to. The pumps are set well below the water line and each suction goes into the lake, but a big hydraulically operated valve keeps out the water when this is necessary.

The outboard suction which reaches down to the bottom when pumping is going on now lies on the deck. It is a 40-ft. piece of 18-in. pipe with a plain pipe bonnet at the lower end and a Barco ball joint at the upper end. A short pipe goes from this joint to a hole



Tank classifier showing the "little smoke stacks"

in a cast-iron plate. When the boat is ready to pump, the plate goes into guides on the side of the ship and is lowered until the hole in the plate registers with the suction pipe. Any leakage around the plate is of no consequence. In fact, holes have to be drilled in the suction bonnet to draw in water, and if these are not open the suction clogs.

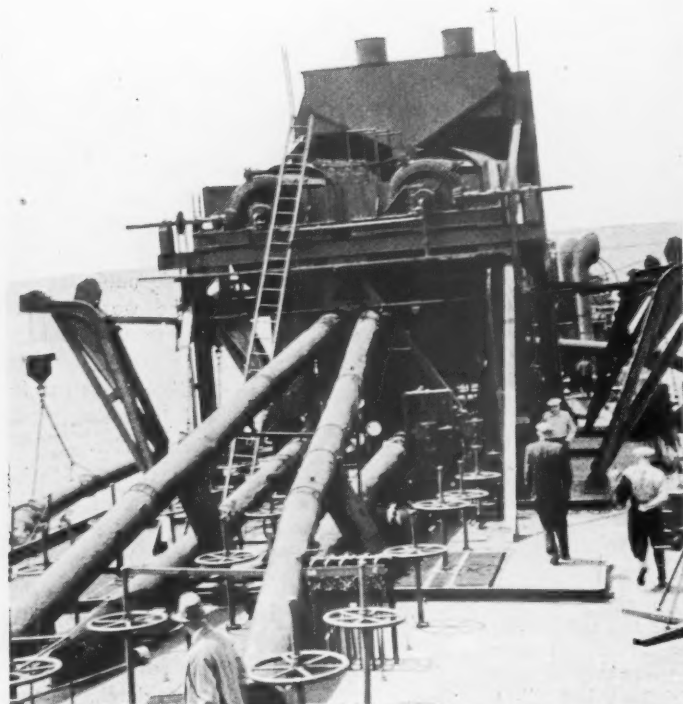
We can go on deck now and note where the discharge pipes of the pump come through the deck. They are fitted with Barco joints, as they have to be given different positions while pumping to the screening plant and while pumping the cargo ashore. Now they have just been disconnected from the shore lines and are being connected to the loading

lines going to the washing and screening plant.

Preliminary Classifiers

The loading pipes, you will note, go into the under side of a queer-shaped tank on top of which are two little chimneys. When the boat was being fitted out last spring, every old-timer who saw them wanted to know what in something or other those two extra "smoke stacks" were for. The secret is here revealed. The tank is closed at the top to prevent splashing in a seaway and the little chimneys provide air vents and receive the first rush of water from the pumps.

This tank is a preliminary classifier for throwing out fine sand. There is no clay in the deposits (although they rest on hard clay), but there is a great deal of fine sand, averaging around 65-mesh in size. The classifier was calculated to throw off two-thirds of the volume of the pump discharge, thus getting off a lot of excess water and most of this troublesome fine sand. It is a simple "flow-through" classifier, the pump discharge going into a surge chamber and then flowing under a baffle to a settling chamber which has about 64 sq. ft. area at the overflow on each side. The remaining third of the discharge goes down a cast-iron chute to the screens. A segmental type gate regulates this flow. This is about half solids and half water. The screening and washing will be described later.



View of the screening plant from above the deck, showing valve wheels and gravel chutes



Davits swing inboard to lay the suction pipe on the deck when the boat is cruising



Ready to lower away on the outboard suction



Showing how the fine sand is run to waste

Locating Gravel Deposit 10 Miles Off Shore

We are about an hour running the 10 miles southeast to the pumping ground. As the wind is in the north it blows the smoke and haze inland and the night is fair. Usually there is a slight haze. "Low visibility" is the mariner's term. But tonight the view of the shore is magnificent. Far to the north, 20 miles or so, one can see the flash from the Lindbergh beacon on the Palmolive building and the lights of the tall buildings by the Link bridge. Then sweeping south the lights of the Outer Drive so thickly set they make a single thread at this distance. The cloud of tinted smoke that glows alternately red and yellow is from the steel works at South Chicago, and the groups of lights to the south and west mark Indiana Harbor, Bufington and Gary, and the few twinkling points to the east are at Michigan City.

Everything is still tonight, but in the fog last night the air was vibrant with the raucous notes of the fog signals. How the captain finds the floating barrel that is our mark in such a fog is still a mystery to me. But

last night the boat ran out at its regular gait, and when the long, narrow beam of the searchlight shot out of the pilot house it promptly picked up the barrel about three boat lengths ahead. The captain tells me that one foggy night he hit the barrel head-on. Of course I know the theory of how it is found by taking distance and direction; nevertheless, a barrel seems a very small mark to shoot at from 10 miles away.

We are on the ground now and two men begin sounding, one at the bow, the other at the center of the ship near the suctions. They call back the depth (in feet, not fathoms) to the captain, "27, 24, 25, 22." The anchor chain goes roaring through the hawse hole; the boat is brought into the wind. Two short whistle blasts say that the stern anchor is down. The boat lies with the wind on her quarter and by pulling on or slacking the lines and by drifting with the wind she can be moved ahead or astern or to either side without starting the main engine or stopping the pumps.

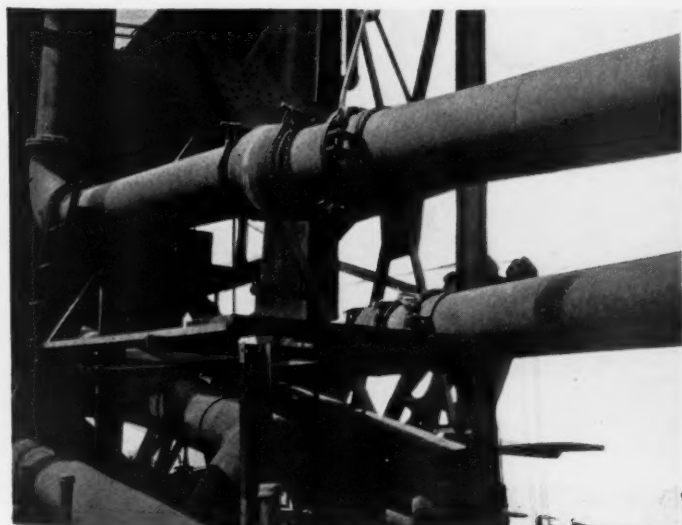
Pumping Begins

The suctions have been hanging overside

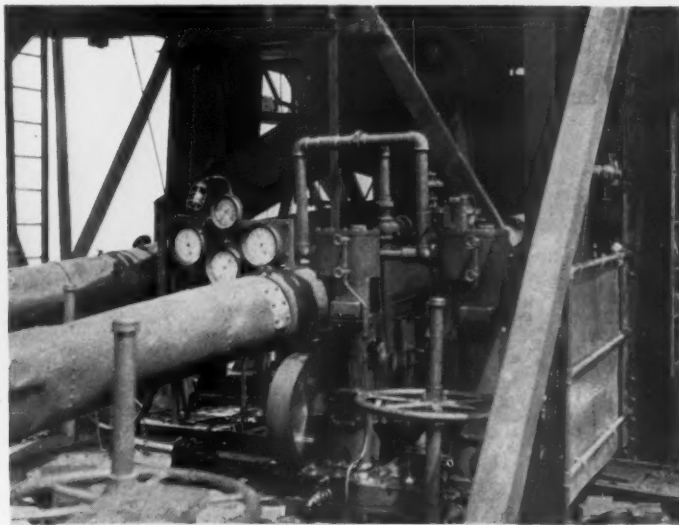
for some time and they are lowered promptly. It takes a few minutes to "build up" the vacuum and then the gravel begins to rattle in the revolving screens. It may be necessary to shift ground several times before the load is made or it may be that one small area will supply it. This depends on the weather as much as anything, for if the wind rises it may be necessary to get into deeper water. And if the waves run high, even deeper water will not help because the suctions will lift off the ground with every rise and fall of the boat.

To get back to the washing plant. In the first place, one notes that it is a double plant, each pump having its own half of the tank classifier, revolving screen and sand classifier. The flow sheet shows the arrangement. The screens were made by the Austin-Western Road Machinery Co. and the drives (roller-chain) and shafting were furnished by the Link-Belt Co. Everything else was made at the Calumet ship yard. Each screen is driven by an Engberg steam engine.

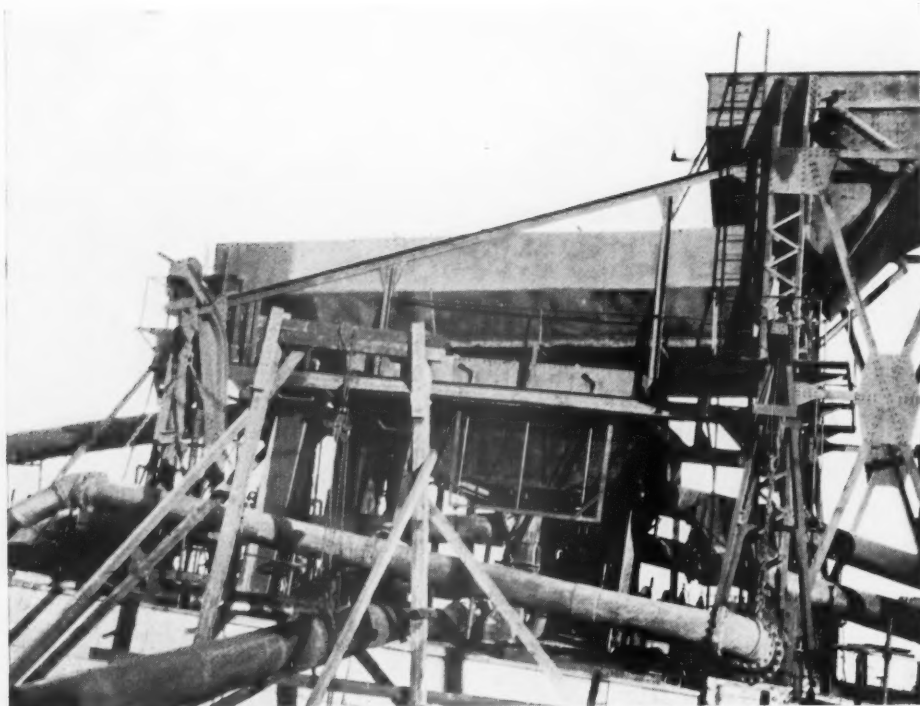
Designing this washing and screening plant was an interesting job. It had to be com-



Plain rubber sleeves with chain wraps used for connections



Engine driving the screen and a view of the pump gages



Side view of the plant aboard the Brazil. The pipes and trestles in front are for pumping ashore

pace and the head room had to be kept to the minimum so as not to affect the stability of the ship. Elevating and conveying machinery was barred, partly because quick deliveries could not be had. And everything must be adapted to working in a seaway. It took three of us to work out the plan, but the results have been, on the whole, satisfactory.

It was my particular job to calculate and design the classifiers and we considered and eliminated almost every form of which I know. We finally decided on a simple settling box 12 ft. long, 6 ft. wide and 6 ft. deep of triangular section. This is divided into three compartments by partitions and each partition has a spigot outlet that can be regulated by a valve handled from the deck. The compartments are kept nearly full of

sand all the time so that the discharge through the valves is a thick mud or quick-sand.

An even gradation may be obtained by mixing the products of the three spigots, slides in the chutes below the spigots permitting as much or little of each as is necessary to be wasted. This works well so far as keeping the gradation is concerned, but it cuts down the tonnage. Familiarity with the deposits has shown that as good results may be had by selecting from the deposit, shifting to coarser ground if the sand is running too fine and to finer ground if it is running too coarse. Even then it is almost always necessary to waste at either the coarse or the fine end and sometimes at both ends. The spigot products vary with the ground worked, but

the following may be taken as an average:

Sieve	Coarse spigot cum. %	Medium spigot cum. %	Fine spigot cum. %
On 4-mesh	11	2	0
On 8-mesh	34	23	4
On 14-mesh	56	39	16
On 28-mesh	71	49	29
On 48-mesh	83	72	54
On 100-mesh	99	97	95

Fineness modulus: Coarse, 3.52; medium, 2.82; fine, 1.98.

The average fineness modulus of these is 2.78, which is lower than we like to have it. By discarding some of the fines it can be brought to 2.90 to 3.1 and we try to keep it within these limits. A good example taken from the boat's records is:

Sieve	Cum. %
On 4-mesh	4
On 8-mesh	21
On 14-mesh	42
On 28-mesh	59
On 48-mesh	76
On 100-mesh	97

Fineness modulus, 2.99.

Although the specific gravity of the minerals that compose it is relatively light (2.58 I made it) the sand is heavy, weighing from 115 to 117 lb. per cu. ft. The shape of the grains as much as the gradation, in my opinion, is responsible for the low percentage of voids. This sand makes excellent concrete; a strength of 1970 lb. in 7 days for a 1-8 mix was noted in one case.

Screening Problems Solved

Screening as well as classifying has its problems with this material. Slotted screens were tried at first, as they had been used the year before. But round holes have been found much more efficient, in fact the production increased nearly 50% after the change to round holes was made. Round holes of $\frac{3}{4}$ -in. and $\frac{5}{8}$ -in. are used on the main section of the screens and $\frac{3}{8}$ -in. round holes on the sand jackets.

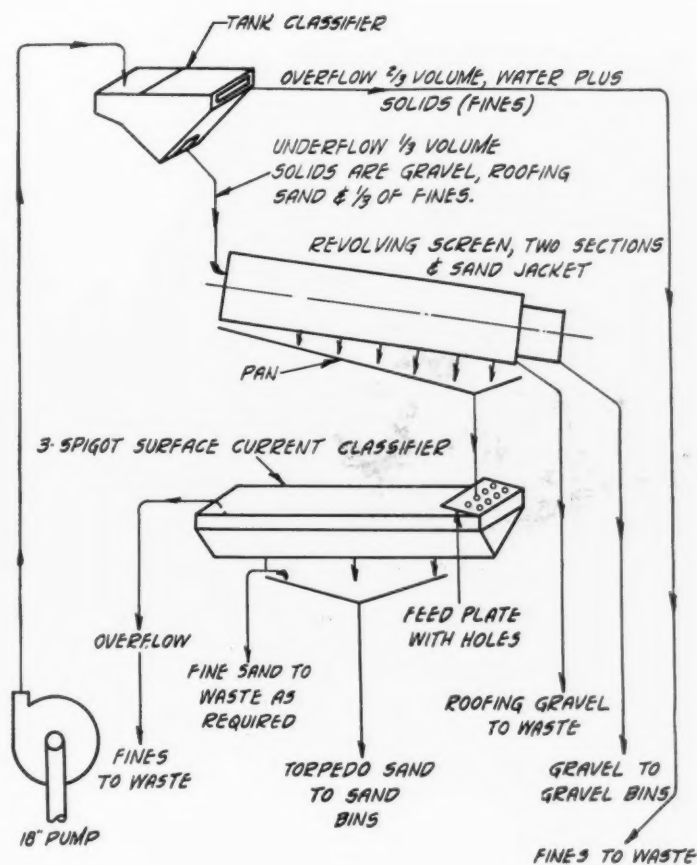
A full set of testing sieves and a spring balance, the only kind adapted to use on shipboard, are carried and samples are tested



Top of screens with rollers. In the background is the enclosed classifier



Sand classifier on the Brazil. Rods in frame at right regulate valves



Scheme of screening and classification, representing one side

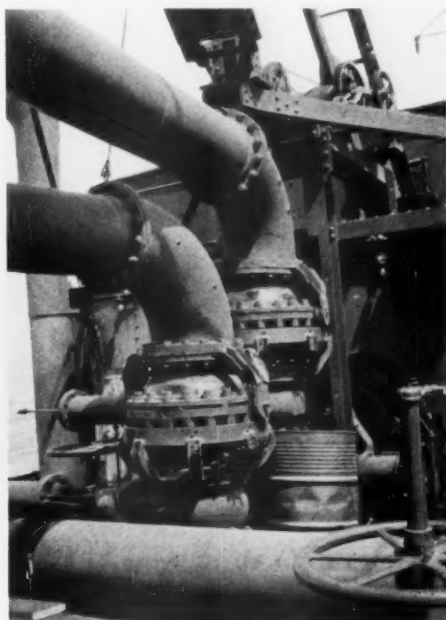
from time to time. The captain and assistant captain look after the classifiers and they are so accustomed to the "feel" of the mixture that they can tell without testing whether it is right or not, so testing is more for confirmation than anything else. When I was on the boat it was my job to see that regular samples were taken and the average gradation for the cargo determined from these, but the results of the samples taken in the yard show that the cargoes tested by the simpler method are about the same.

Bouquets for the Crew

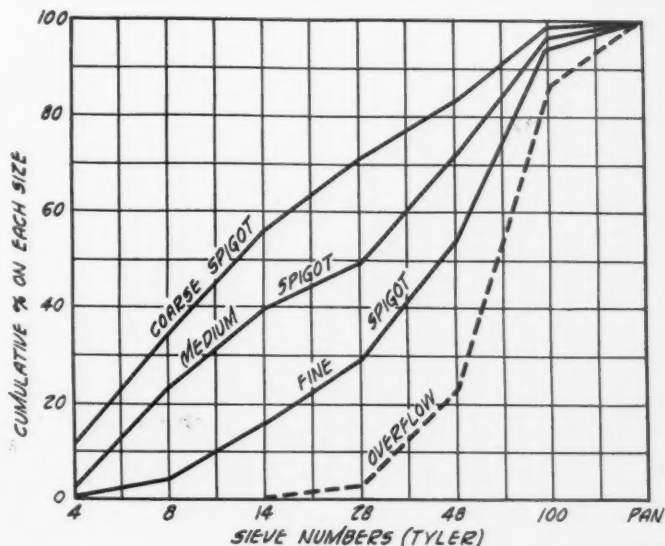
This seems a good place to speak of the high quality of the men who make up the *Brazil's* organization. They can do almost anything and show as much zest for running the sand plant and making good materials as they do for handling the ship smartly and keeping the engines tuned up. The chief has charge of a repair crew that is ready at any time, day or night, to repair a chute, tighten bolts in the screen or any other of the thousand and one little things that are necessary to keep the plant and ship efficient. Many of the men have visited almost every port in the seven seas and they know how to talk intelligently of what they have seen and heard. It has been a privilege and a pleasure to have been associated with such men.

Also let me pass a well deserved bouquet to the steward and his assistants. This morning we had canteloupe, cream of wheat, bacon and eggs and toast and if that wasn't enough

there were doughnuts and coffee cake. At noon we had soup, roast pork and apple sauce, lettuce and tomato salad and pumpkin pie. Supper will probably give us a choice between steak and fish and the usual trimmings. And all of it most excellently cooked. And late tonight, if you get hungry, you will find a long table spread with cold meat, smoked fish, ham, cheese, cake, sauce and so on, and there will be a pot of hot coffee on the range. No wonder the lake boats have such a reputation for good feeding. One of the mates who usually takes a cruise on salt water in the winter time told me this morning, "The best I ever got at sea is far



Pump discharge pipe with flexible joints



Work of the sand classifiers on the Brazil

behind the worst I ever got on the Lakes." But on both sea-going and Lakes-going sailors' fare has come a long way from the salt horse, lobscouse and other dreadful messes of the old days. A well-paid and well-fed man, who has too much self-respect to be anything else, is worth a dozen of the other kind; and ship owners know this now.

Home-Bound with Cargo

The weather has been kindly and we have taken on our cargo of 1400 cu. yd. in 10 hours of steady pumping. Once we did it in seven hours, but the sand ran so good then that hardly any of it had to be thrown out by the classifiers. In fill sand the boat used to load quickly and carry from 1500 to 1800 cu. yd., but the sand and gravel material weighs about 15% more so the yardage is cut down. The depth at the dock dictates the depth to which we can load; just as our city streets are too narrow for modern traffic, so our harbors and channels are too narrow and too shallow for modern shipping. I have been on the *Brazil* in some places, going into Michigan City was one of them, where there just was room to squeeze through a drawbridge and stay off the bottom. It takes smart handling and quick decision to put a boat in such a place without injury.

But at Yard No. 3 in South Chicago there is no such problem and the boat is quickly brought into place. The lines go out and hold the boat as she is backed until the discharge pipes on deck are exactly in line with those on shore. Twenty minutes later the rubber sleeves that connect them are on and made fast with chain wraps.

Dewatering Sand a Hard Problem

The sand is pumped ashore through a line that returns to the boat, as no solids either fine or coarse may be permitted to run into the harbor. Midway of the line is a dewatering device which takes out the sand, only a little fine material returning, which is run into the after bin and recovered when



Marine Dredge and Gravel Co. No. 3 yard, South Chicago



The author is seen here as a sea-faring man

that bin is discharged. The dewatering of the sand has proved the hardest problem to solve at a reasonable expense. Heavy dewatering elevators of the type used on the big dredges of the Ohio would do it nicely but their installations with the stockpiling conveyors needed would run into too much money. Meanwhile the present arrangement works pretty well. With care in handling there is not much segregation of the sand and as all of it is stockpiled before loading out, the resulting product is as uniform as most sand plants turn out. It is hoped to improve this part of the work another season.

Segregation is bound to occur wherever sand is run with more than a little water. It occurs in the bins of the *Brazil* as well as where the cargo is pumped ashore. But by manipulating the discharge gates carefully the product is kept uniform during the pumping.

Cargo-Discharging Facilities

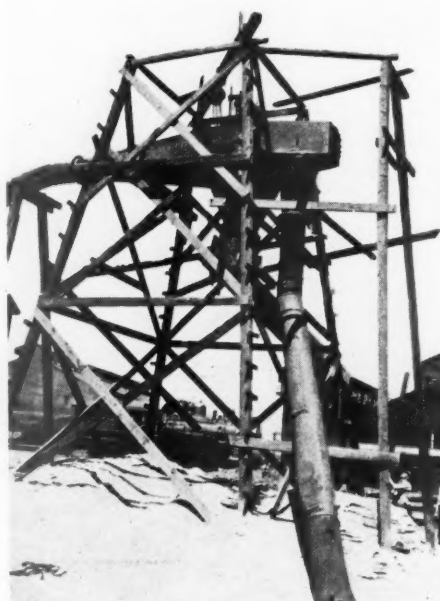
The cargo bins are not merely divisions of the hold; they are independent structures with passageways between the bin walls and the sides of the ship. Three tunnels are below the bins into which water may be admitted from seacocks. Doors in the roofs of the tunnels connect them with the bins and the tunnels have connections to the pumps.

When a bin is to be discharged water is admitted to a tunnel and a pump is started. Then doors above the tunnel are opened so that the sand feeds in as fast as the water will carry it away. The center tunnel is used first, then the side tunnels and sprays of water from revolving pipes wash down the bin walls and the bottoms. A three tunnel boat is necessary where the bins are used for sand following gravel or vice versa, as a single tunnel boat cannot be washed so cleanly.

Gravel offers less difficulty in dewatering. It is pumped through a pipe that has openings over inclined screens that take out the water and any sand or fines that may have

been accidentally included. At the North Yard, at the mouth of the Chicago river, there is a neat arrangement for dewatering and screening mounted on a high steel trestle. Both yards have gasoline-driven crawler mounted cranes (Moore "Speedcranes") for stockpiling and loading out material. Deliveries are made by both truck and railway car.

It takes from three to five hours to pump out the cargo. Then pipes are disconnected,



Sand dewatering device

lines are cast off and away goes the *Brazil* for another load, for time is indeed money where a ship is concerned and even a minute has its value. If the boat leaves me behind I confess to a feeling of regret, for life is very pleasant aboard—at least in summer weather. When I began to take these trips I thought myself something of an invalid. But evidently this was an error, for every day I have felt stronger and happier. Most of us are half amphibian and we feel better

where we can see the sky over blue water and there is no tonic like a voyage even though it be the 10-mile trip from South Chicago to the pumping grounds.

The office of the Marine Dredge and Gravel Co. is in the Mather Tower, 75 East Wacker drive, Chicago. J. C. Hoskins is president in charge of all operations, and Jean March Allen is vice-president. Mr. Allen is a well-known designer of dredges and has written several articles for *Rock Products*. The writer's only connection with the company has been that of consulting engineer, first to assist the design of the equipment and afterwards in its operation.

The Building Code Committee

ONE OF THE MOST important technical bodies serving American industries today is the Building Code Committee, which was made a part of the Department of Commerce by Secretary Hoover in 1921.

The committee has issued six comprehensive reports dealing with the construction of small dwellings, plumbing requirements, minimum live load specifications for office buildings and others occupied by more than one tenant, masonry wall requirements, allowable stresses on building materials and a uniform arrangement for building codes. William K. Hatt of Purdue University is chairman of the committee.

Evidence of the usefulness of the building code committee's work is seen in the extent to which local legislation has been influenced by its recommendations. A canvass of 858 municipalities showed that 281 were revising their building codes and 191 their plumbing codes. As an instance of problems which confronted the committee, and they were many, it was found that in the city of New York one office building was designed for floor loads of from 50 to 100 lb. By gathering together data the committee ascertained that the average load was only 11 lb. per sq. ft. and even in the cases of heaviest occupancies 50 lb. was unusual.

Testing of Lime Kilns

Part I.—General Considerations

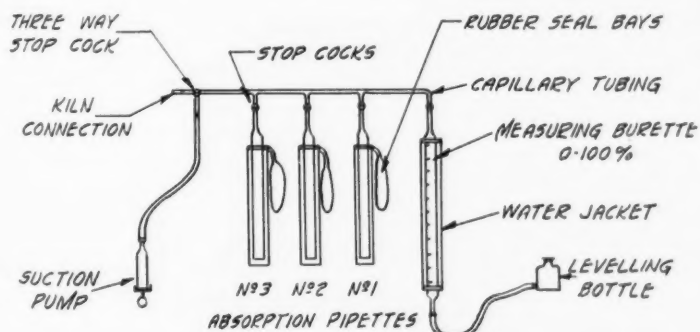
By Victor J. Azbe

Consulting Engineer, St. Louis, Mo.

LIME KILN testing is not exactly a simple process; in fact it is quite difficult, much more difficult than boiler testing. To weigh the coal and lime and so determine the efficiency is simple, even though such tests ought to be of at least one-week duration. But supposing the efficiency is found to be bad, or good, little will be known as to why conditions are so. The purpose of testing evidently should be to get data which will permit of definite deductions enabling one to make improvements or enable one to duplicate the same conditions on another kiln in the same or in another plant.

The most useful test is analysis of gases, but to interpret the results properly one must have some experience. A sample taken at one point in the kiln may not be the same as one taken only a few feet away; but the sample will be representative of that section, so if a number of samples are taken at different points considerable information can be gathered.

Results of gas analysis reveal information of two kinds: First, information about *Combustion*; that is, whether fuel is burned with too much air or whether there is incomplete combustion due to an insufficient amount of air or imperfect mixing; and second, information about *Kiln Performance*, its fuel efficiency and its fuel-lime ratio. If combustion is to be studied, then the gas sample analyzed must be of the stream actually coming up through the kiln, entirely undiluted by any air finding access to the kiln top. The only way to assure such a sample is to submerge the sampling pipe below the surface of the stone for several feet, as shown in Fig. 2. The best way of doing this is to insert the pipe when rock in kiln is low and then charge stone on top.



Apparatus for securing kiln gas analysis. Absorption pipettes: No. 1 for carbon dioxide (CO_2) containing caustic potash solution; No. 2 for oxygen (O_2) containing pyrogallol acid solution, and No. 3 for carbon monoxide (CO) containing cuprous chloride solution

Editor's Note

FLUE GAS analysis offers a practical method of lime-kiln control. The efficiency of any lime kiln can be increased by intelligent use of proper control instruments. How to compute efficiency and simple things that any operator can do to increase efficiency, are given in understandable language.

The first important requisite to ideal kiln performance is that combustion be complete; that is, that there be enough air supplied to completely burn the fuel so there is no carbon monoxide (CO) in the gas escaping from the kiln. The second requisite is that only enough air for complete combustion be supplied and no more; that is, there should be no oxygen in the sample of waste gas analyzed.

Now these ideal conditions are never entirely possible in normal operation, and one can merely aim to approach them as nearly as possible. Just exactly what the permissible deviation should be depends upon the type of the installation. Hand-fired installations naturally will have a fluctuation caused by the periodic firing, gas producer equipped installations will give gas more constant in quality, while with natural-gas-fired kilns it will be even more so.

Hand-Fired Kilns

Fig. 3 shows combustion conditions found in the best hand-fired plant of

the many tested by the writer. This plant, located in Canada, had very smoky kilns, but their efficiency was close to 40% which, considering the conditions and the fact that high calcium lime was burned, is very good. The reason for this is as shown by the chart. While periodically there was carbon monoxide in the gas, it never was very high and while alternately there was excess air, it also never exceeded a reasonable figure. Of the 18 tests made only five show ideal conditions, but the others never deviated far either way from the ideal.

It probably was noted that of the three gases usually determined, carbon dioxide, oxygen and carbon monoxide, we are considering here so far only the last two. While carbon dioxide has to be determined along with the others, it in lime kiln practice is of no value when judging combustion. It, however, has considerable value for determining of lime fuel ratio, which matter will be taken up later on.

When hand-fired kilns are improperly operated, they may lean either one way or the other. In a certain plant (Fig. 4) it was found that carbon monoxide always was present, that in three hours of operation there was never enough air to burn all of the combustible gas. While the CO fluctuated in amounts, it always was present. After the fire was cleaned, it varied between a trace and 1%. As time went on, and fire on the grate got dirty, its amount increased and it fluctuated between 1 and 4% and at the end

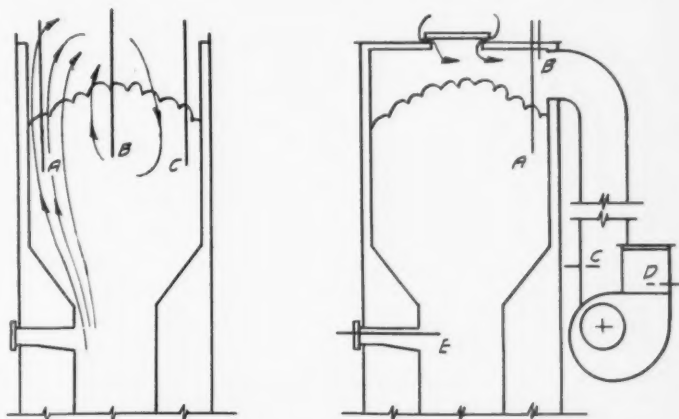


Fig. 2, left. Open top kiln sampling conditions. A is best location for sample pipe. B and C are not considered good. Fig. 2a, right, sample pipe locations in closed top kiln. A, satisfactory but may indicate only a portion of the kiln. B, unsatisfactory because it may be in a stream of inleaking air. C, satisfactory for kiln average if analysis is corrected for inleaking air. D, more satisfactory. E, not satisfactory because it does not give kiln average

cined for every pound of pure carbon substance burned, the volume of gas from the stone would be 32 cu. ft., the total volume of gas coming up through the kiln would then be 174.87 cu. ft. of which CO_2 would be 61.89 cu. ft. or 35.4%. For magnesium oxide the percentage would be 39.7, and for dolomitic limes an intermediate of these two, the exact amount depending upon the amounts of CaO and MgO in that particular lime, also upon how thoroughly it is burned.

To obtain the exact representative gas sample, as previously explained, is not a very simple matter. It is, however, only necessary for judging of combustion. The writer, during his studies of lime kiln performance, found that even though the sample is diluted with leakage air, the fuel-lime ratio can still be determined. If excess air is used to burn the fuel, the volume of gas passed through the kiln will be increased, oxygen percentage will increase, while CO_2 percentage will naturally decrease. The amount of oxygen will be a direct indication of the amount of dilution, and if this is known it also is known what the CO_2 percentage would be if there were no dilution. Thus we can say that the relation of oxygen to carbon dioxide once established cannot again be destroyed, and this regardless of where excess air leaks in, through the cooler, or burners, or kiln top or even a leaky sampling pipe. The relationship of the two is fixed in the burning zone of the kiln where lime is made and varies directly with the amount of lime made per pound of coal.

One would be entirely correct in saying that if the instruments were sensitive enough to record the true relationship of CO_2 and O_2 , one could sample air on a hill adjacent to the lime plant, in the direction the wind is blowing the kiln gas, and still determine correctly the ratio. Of course, the instruments are not sensitive enough to do this properly.

We must make only one reservation, which would not be necessary if carbon—say coke—were actually the fuel used, as it was for the purpose of the above example. Most fuels used in addition to carbon contain also hydrogen, which burns to water, and which condenses in the gas-testing instruments, so it does not appear in the analysis report. The oxygen of the air combines with the hydrogen, but the nitrogen, the main portion of the air, is inert; it passes through the kiln unaffected; however, it affects the analysis by increasing the volume and reducing the CO_2 percentage. So while coke burned under boilers will give gas that theoretically will have 20.9% CO_2 , the products of combustion of bituminous coal will have only about 18.5%, oil 16%, natural gas, which is particularly rich in hydrogen, only 12% CO_2 . If now these fuels are burned in a lime kiln, the CO_2 percentage in the waste gas will naturally be less with high hydrogen fuels. Since that ordinarily would indicate lower kiln efficiency, the hydrogen must enter the calculations. Fig. 8 illustrates graphically weights, volumes and percentage re-

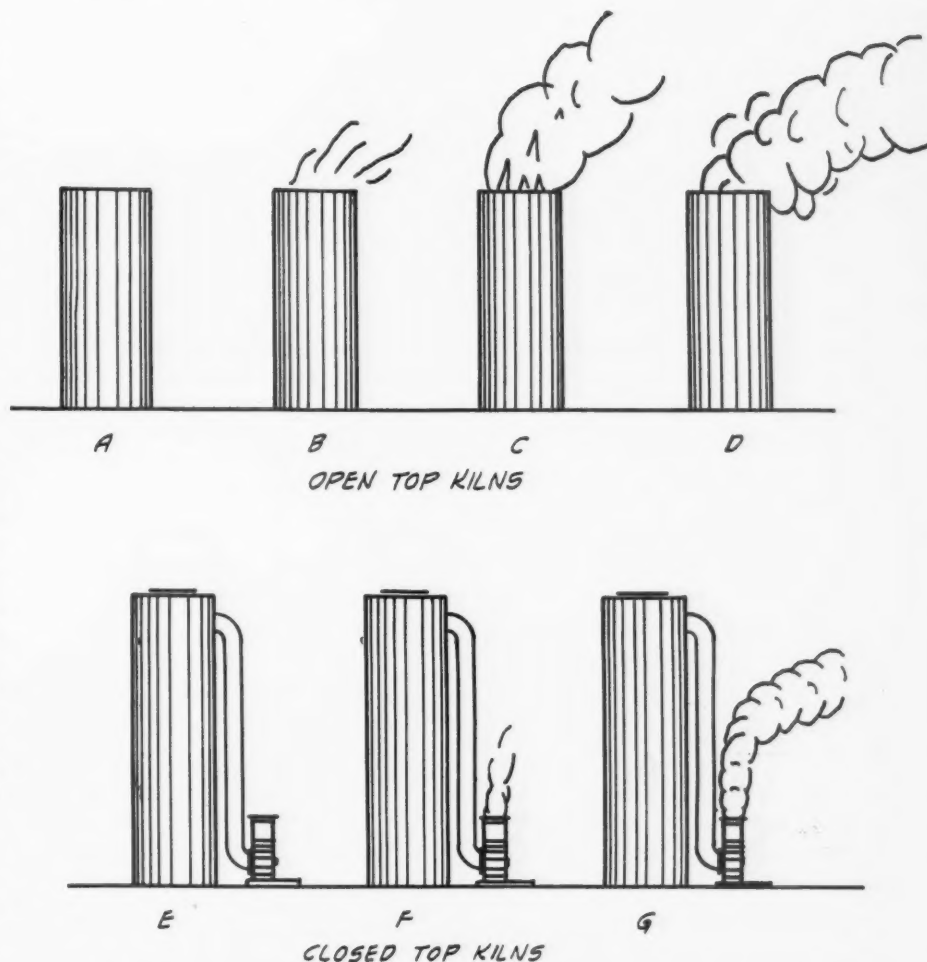


Fig. 7. Visual observance of lime kiln conditions. A, too much air; B, light haze indicating very satisfactory condition if least reduction in air supply results in smoke; C, flame on kiln top indicating very wasteful condition; D, heavy smoke indicating very poor condition and is accompanied by the escape of too much carbon monoxide (CO) gas; E, clear stack, too much air; F, very light haze, the best condition; G, black smoke, indicating lack of sufficient air for combustion and the presence of carbon monoxide gas

lationships of gases with various ratios with 11,500 B.t.u. bituminous coal and high calcium limestone.

With oil, natural gas and ordinarily even with producer gas, conditions are very constant and the fuel fed to the kiln is constant in hydrogen content. When coal is hand-fired, that may be different. Hydrogen is all in the volatile portion of the coal. Immediately following a fresh fire, the combustible gas rolling with the air into the kiln is rich in this volatile matter. The volatile matter distillation takes place at comparatively low temperatures early in the period between two firings. A certain CO_2 percentage at this stage indicates a higher ratio than it does during the latter portion when the fuel burned is mainly coke lying on the grate. Of course, the whole tends to average itself out, but it still is worthwhile to realize that there is a difference.

Use of Chart of Efficiencies

The chart, Fig. 9, is extremely useful to directly determine kiln efficiency and lime-fuel ratio if the kiln gas analysis is known. This chart is calculated for bituminous coal of average hydrogen content. The lime

burned contains 95% CaO . For dolomitic lime, or when the fuel is oil or natural gas, this chart is of no value.

Supposing the gas analysis is 6½% oxygen and 21% CO_2 and no CO , and further assuming that the fuel has a heat value of 12,000 B.t.u. per pound, just what information can we obtain from the chart? Running a line from 6½% oxygen clear across we find that this amount of oxygen indicates that the kiln gases are 31% free air. If we run a line from 21% CO_2 to where it intersects the oxygen line, we find ourselves at a point indicating that kiln fuel efficiency is 36%, also that about 14.2 lb. of dry gas pass through the kiln for every 10,000 B.t.u. given off by the burning fuel. Dropping now, first parallel with efficiency lines, then as shown by the dotted example line, to the 12,000 B.t.u. coal heat value curve, we find that the ratio pounds of lime per pound of coal are 3.3 to 1.

If the coal were of a higher grade containing 14,000 B.t.u. per pound, while the efficiency would be the same, ratio would be 3.9 to 1. The efficiency is a definite figure always, while ratio means nothing if fuel value is not simultaneously stated. It is possible

for one fuel to be so poor and the other so good that one may have a ratio of fully a pound less than the other, and still the efficiency may be exactly the same in both cases.

Efficiency is determined by the use of the following equation:

$$\text{Efficiency} = \frac{\text{Heat value of fuel}}{\text{lb. of lime per calcium oxide burned per lb. of fuel} \times 1378}$$

The figure 1378 is the amount of heat required for each pound of 100% CaO made.

Other Deductions From Chart

Experimenting with the chart one can form many interesting deductions. Assuming that there is no oxygen in the gas and the carbon dioxide is 30.2, the efficiency still is exactly the same. There is one important difference though and this is, that while the kiln was operated with $6\frac{1}{2}\%$ oxygen, the pounds of gas per 10,000 B.t.u. generated

were over 12, while when operating with no excess air the gas was approximately 11 lb., a difference of practically 20%. If the excess air did not come through the kiln, it does not matter, but if it did, that is, if fuel is burned with this amount of excess air, it matters very decidedly because naturally this idle air is heated in passing through the kiln and it escapes hot, thus unnecessarily wasting heat that could be used for making of lime. Just how much this may amount to will be discussed later.

If it happens that the kiln gas contains also CO, it must also be taken into consideration. Fortunately, the volume relationships are such that half of the CO found should be added to CO₂ and that amount used for determining of efficiency. If CO₂ is 28% and CO 4%, half CO added to CO₂ makes 30%, which is the correct figure to use in determining kiln efficiency or kiln

lime-fuel ratio with the aid of this chart.

The chart, Fig. 10, is calculated for bituminous coal and magnesium limestone having a calcium-magnesium ratio of 60-40%. The chart, Fig. 11, is calculated for natural gas and high calcium limestone.

When analyzing lime kiln gases one must, however, remember that the lime kiln is a large heat reservoir, that even if one stops burning fuel entirely, a certain amount of lime will continue to be produced and that for a considerable period of time. For example, when kilns are hand-fired, at the time the grates are cleaned, when hardly any coal at all is burned on the grates, the heat stored in the lime will continue to penetrate into the limestone core and CO₂ gas will continue to come from the kiln together with the free air flowing up. Naturally under these conditions a very high ratio would be shown.

A somewhat similar condition is created when the fire is blanketed with fresh coal. The ratio will be higher until the products of combustion and combustible gases create a new path through the fuel bed. In the case of gas-fired kilns, if the gas and air are shut off, the analysis of waste gases may reveal as high as 50% CO₂. The same condition can occur when oil or natural gas is being burned and they are shut off. The kiln will continue to make lime for a considerable period. Again one should remember that the charts previously explained are calculated for average conditions, a fuel having about $4\frac{1}{2}\%$ of available hydrogen. But the fuel ordinarily burned, that is coal, while in the average it has $4\frac{1}{2}\%$ of hydrogen, it really consists of two kinds of fuels. The volatile gaseous matter first given off when the coal is heated, which contains as high as 30% of hydrogen and the fixed carbon that burns on the grates, the coke, which contains no hydrogen. The products of combustion of the latter will be higher in CO₂ than of the first, and so a given amount of CO₂ in the kiln stack gases will mean a lower ratio. In other words, when hand firing, immediately after a fresh fire the ratio may be affected in two ways. The fact that the bed was blanketed with fresh coal would reduce the amount of products of combustion and so increase the proportion of CO₂ from limestone, giving a fictitiously high ratio. Second, at this time the volatile matter rich in hydrogen would be burned, which would reduce the CO₂ content of products of combustion and so tend to show a ratio lower than actually obtained. It is possible for these two to balance each other, but ordinarily the first tends to predominate. When producer gas is used, or oil or natural gas, the fuel fed is of constant quality and constant volume, and results of analysis are exactly representative of the kiln performance.

The above may appear that the possible variations from the exact would make the effort at gas analysis futile, a waste of time, so to speak, but this is not so. The one who is thoroughly initiated into the subject, who is able to sense and interpret the variations,

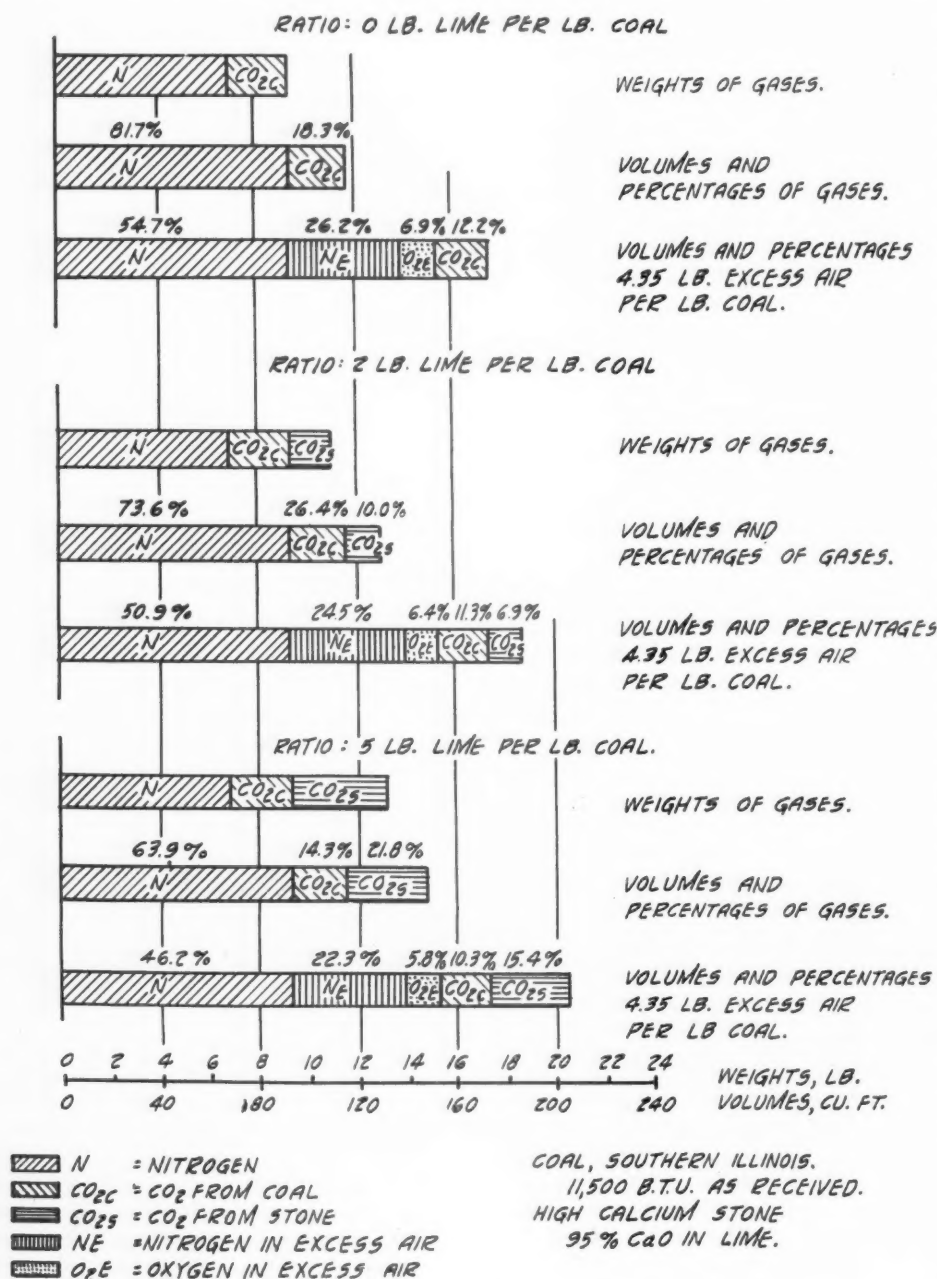


Fig. 8. Weights and volume of kiln gases per pound of coal

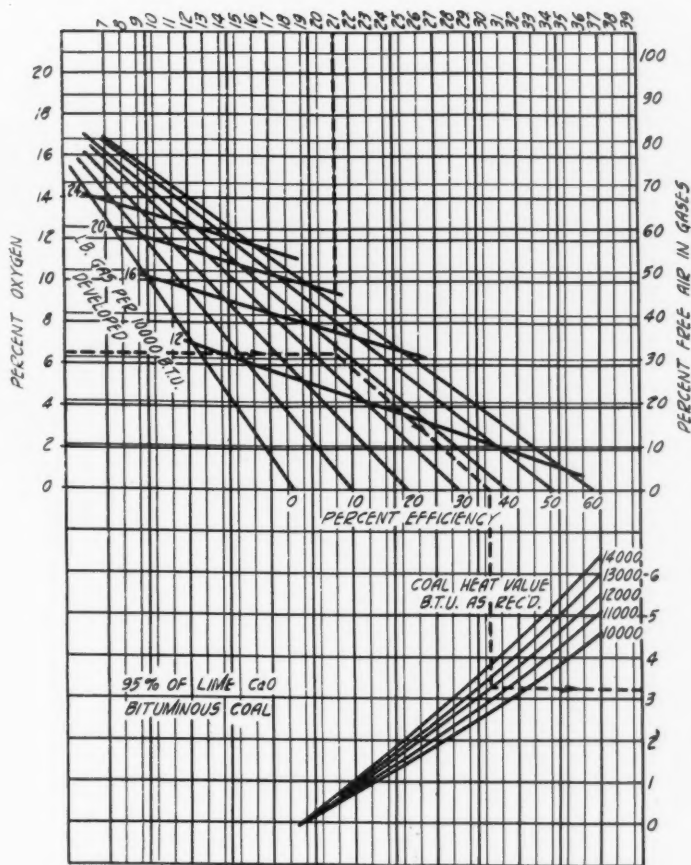


Fig. 9. This chart is useful for determining kiln efficiency and limestone ratio if gas analysis is known. Many interesting deductions can be formed from this chart

derives still more information than otherwise would be possible, and the one who is not quite so expert gets so much of value anyway that occasional inaccuracies do not seriously matter.

Irregularities of Kiln Performance

Unfortunately, a kiln does not work uniformly at any of its cross-sections. One who is conversant with the proper use of the gas analysis machine and interpretation of results received with it, can undertake most interesting exploring expeditions. The writer found in a certain kiln all lime along a vertical line to 20 ft. above the firing eyes, while at the same time there was core in the drawn lime and the overall efficiency was very poor. Improper drawing, improper trimming, were responsible. Lime was not drawn from kiln sections where it was made the fastest. These sections, because there was nothing to absorb the heat, became very hot; for that reason they drew hot gases, to the detriment of cooler kiln sections, which action was cumulative, so virtually a chimney within the kiln was formed, a kiln within a kiln. This was discovered because the gas drawn 20 ft. up from this hot zone contained only the ordinary products of combustion, no additional CO_2 that comes from limestone decomposition. In this way one who has a certain amount of persistency can determine how the corner or side sections are working, and many other items. An effort to illustrate this was made in Fig. 12.

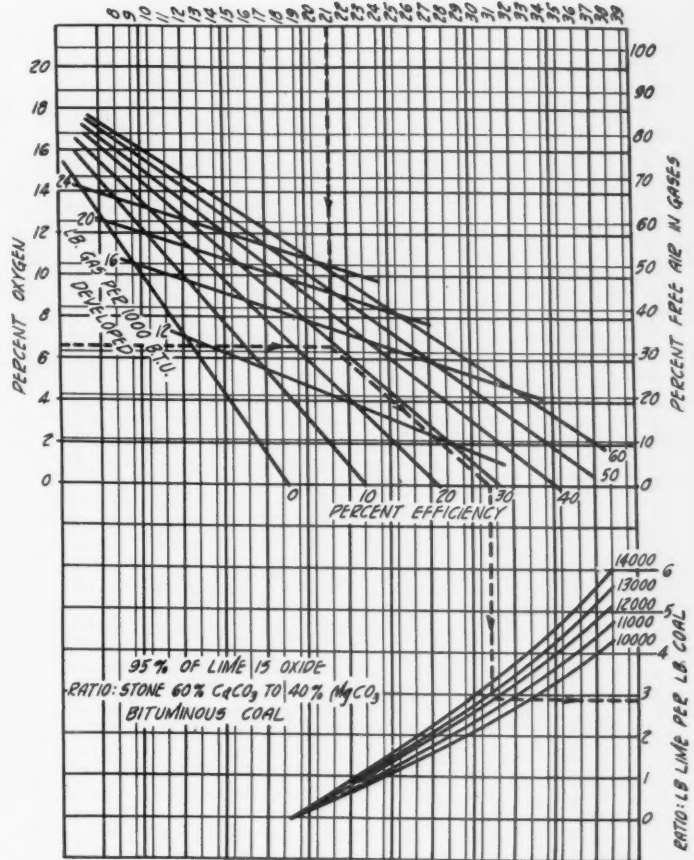


Fig. 10. Calculated for bituminous coal and magnesium limestone having a calcium magnesium ratio of 60-40%

At another time the writer discovered on a certain kiln, operating very inefficiently, that the air sunk down from the top through the stone for a distance of over 15 ft. The air in this case could not have come up from below, but it was found lower than the mid-point of the kiln with the gas testing ma-

chine. The condition was very surprising and impossible to be found by any other means. On one side of the kiln the air was sinking down; midway it mixed with products of combustion coming up, then the two together passed out, using the other side of the kiln. After finding this, one needed no

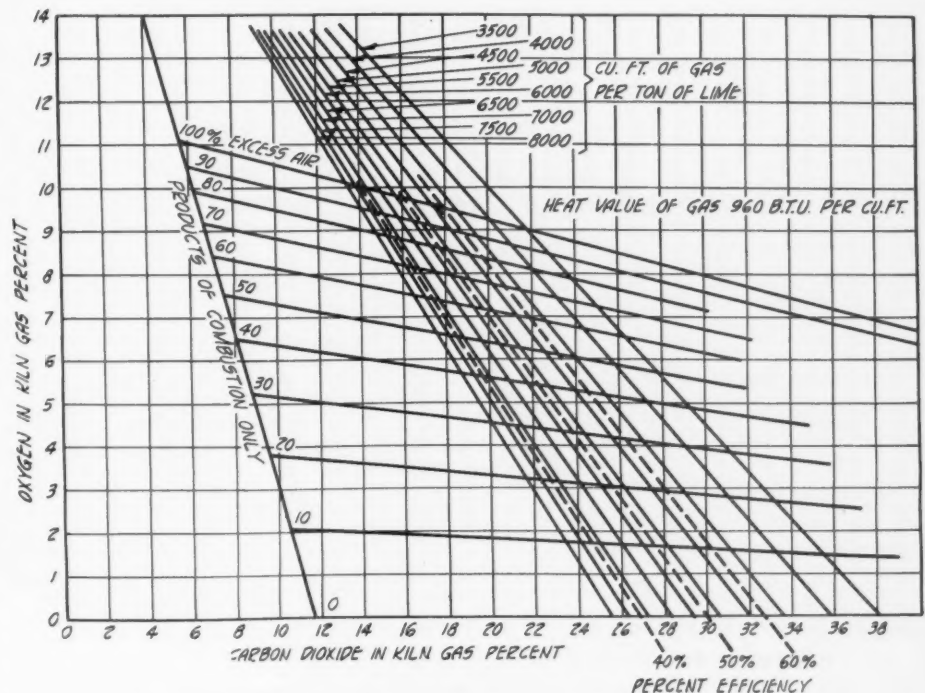


Fig. 11. Calculated for natural gas and high calcium limestone

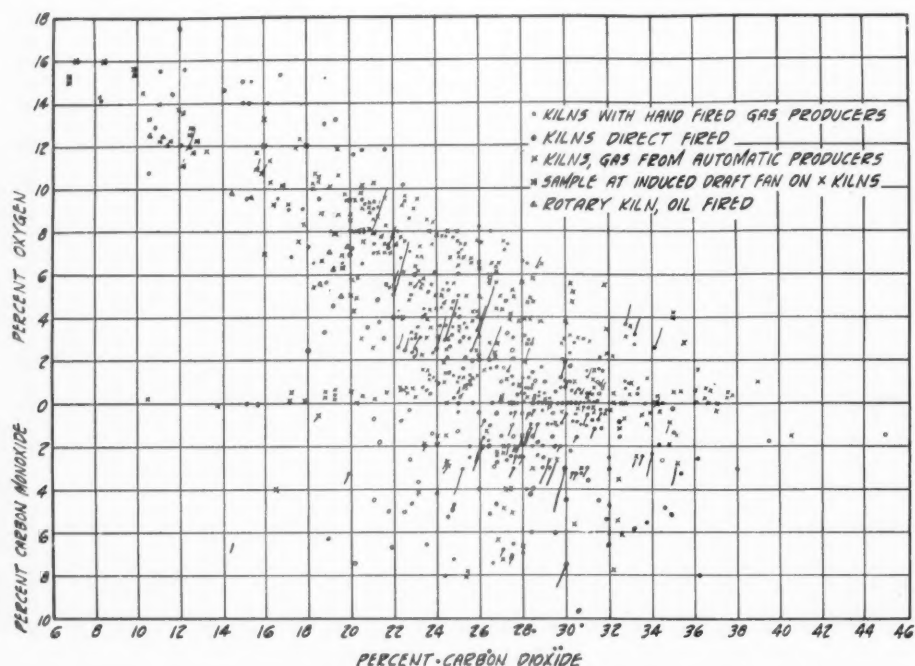


Fig. 13. Data on 750 gas analyses from some 25 different kilns. The engraver cut off one direct-fired kiln analysis which should be at the intersection of the zero line and what would be 48% on the vertical scale. Close proximity to press time prevented remaking the cut

more to wonder that efficiency, as well as capacity of this particular kiln, was so low.

It would be well also to caution that when gas samples are taken at temperatures much higher than 1000 deg. F., one must not use ordinary steel pipe to draw the gas samples. The red hot pipe metal will change the gas composition by withdrawing oxygen, which

gives inaccurate results and conclusions. For these purposes, nickel-chromium pipe should be used.

Fig. 13 presents data of 750 gas analyses for CO₂, O, and CO, determined on some 25 different kilns, being part of the number of analyses made by the writer and his assistant. On this chart all imaginable operating conditions are represented, the very best with the highest possible ratio, conditions when no lime was made at all, conditions so bad that the air passing through the kiln cooled rather than heated the lime, conditions when there was such a deficiency of air that waste gases contained over 10% of carbon monoxide and the flame of a match would have ignited them.

On this chart, the best results are those at 37% CO₂. No CO and no O were obtained on a gas-fired lime kiln correctly designed and properly operated. The worst are when CO or O exceeded 10% or when there was only little oxygen or carbon monoxide, but the CO₂ was low, that is, below 28%.

An extended study of this chart enables one to form mental averages, when it is revealed that gas-fired kilns, suitably proportioned and supplied with gas from automatically fed producers, are inclined to maintain the highest efficiency, and that hand-fired kilns hardly ever reach up into regions occupied by them.

(To be continued)

Magnesian Limestone and Some of Its Problems

AMONG THE OTHER important problems for which British owners of magnesian limestone are seeking solutions are the following, according to Alfred B. Searle,

English consultant, in a paper read before the British Institute of Quarrying:

1. A means of burning the stone commercially without overburning any part of it.
2. A means for quickly and completely hydrating lime, using the word "completely" in the sense that no damage is done when the "hydrated" lime is in use.
3. A means for separating the magnesia on a commercial scale so that it can be used for purposes for which imported magnesite is now employed.
4. An authoritative statement as to the precise effects of magnesia on plant life.
5. A cheaper means of dust-burning dolomite or highly magnesian limestone than the use of the ordinary electric arc furnace or blast furnace.
6. New uses for magnesian limestone and the lime made from it.

Mr. Searle states that it should be clearly understood that there are at least three kinds of magnesian limestone and an unknown number of mixtures of two or more of these kinds in different proportions. (1) A definite chemical compound containing 54.35% calcium carbonate and 45.65% magnesium carbonate, i.e., equal molecules of each; (2) a less definite compound—possibly what is known as a "solid solution"—from which the magnesium carbonate can be readily separated; (3) a simple mixture of the two carbonates in any proportions.

It is very unfortunate, Dr. Searle says, when all three substances are termed "dolomite," as confusion is certain to result. This term, he states, should be confined to the first of these substances, the others being known as magnesian limestone.

Building Permit Status

THE PRESENT slack condition of the building operation field is a topic of discussion for the reason that this business controls such a wide variety of commodities. Building permits serve as a gage for determining the condition of building activities, so the figures for the first half of this year compared with the first six months of 1929 should be of interest. They are as follows:

	1st Half, 1930	1st Half, 1929
New York (P. F.)	\$203,622,725	\$ 679,965,306
Los Angeles	39,712,901	54,071,599
Chicago	38,089,900	115,423,700
Philadelphia	36,106,830	59,486,200
Detroit	27,486,168	55,830,545
Cincinnati	24,279,542	16,437,000
Baltimore	19,984,240	19,180,760
Washington	17,904,567	41,539,315
Seattle	16,932,380	20,508,300
Milwaukee	16,633,420	20,484,499
Cleveland	13,952,225	18,539,750
Boston (P. F.)	13,643,651	28,157,750
San Francisco	12,548,929	18,220,361
Oklahoma City	10,484,780	11,312,020
Pittsburgh	9,971,454	18,190,003
St. Louis	9,304,728	15,980,089
Houston	8,933,451	18,302,723
Kansas City	8,202,075	6,094,500
Newark	7,545,434	14,893,952
St. Paul	7,127,170	4,427,504
Memphis	7,004,468	4,558,034
Jersey City	6,574,235	10,083,651
Akron	6,432,418	11,275,938
Minneapolis	6,366,855	14,426,185
Buffalo	6,254,465	7,787,929

\$575,099,011 \$1,285,177,613

(P. F.) indicates plans filed.

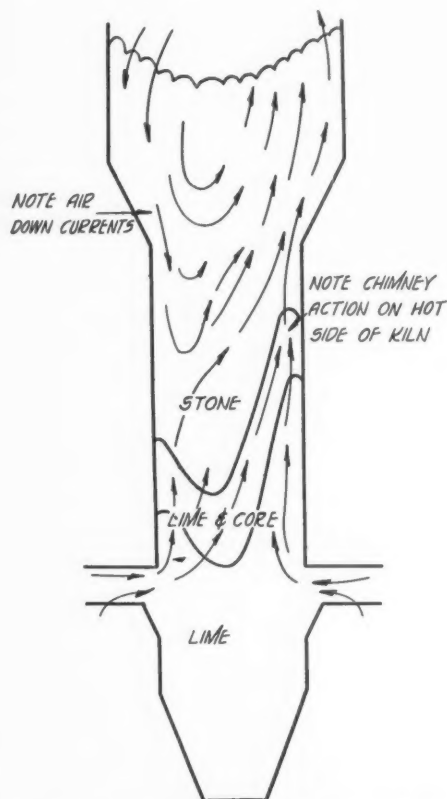


Fig. 12. Sketch to illustrate unbalanced conditions and reasons for poor lime kiln performance

Developing Cyanite in North Carolina

By H. J. Bryson

State Geologist, North Carolina

DURING THE PAST YEAR or two, considerable interest has been shown in the cyanite deposits of North Carolina. If present plans mature and the tests that are now being carried on by two companies prove satisfactory, in all probability this mineral will be produced commercially in this state within a short while. One of the companies expects to consume its entire output locally, while the other will produce several grades for the various ceramic industries.

Cyanite has always been classed as a metamorphic mineral belonging to the sillimanite group which has the formula Al_2SiO_5 or $Al_2O_3 \cdot SiO_2$. The color is white to blue; sometimes the center of the blade is blue with white margins. It is sometimes gray, green, brownish to black in color. The luster is vitreous to pearly; hardness is from 5 to 7, 5 parallel to blades and 7 at right angles.

Occurrence

Cyanite occurs principally in regions where the rocks have been highly metamorphosed. In North Carolina and adjoining states it is found in the Carolina gneiss, a rock which was probably in the beginning a high aluminous sedimentary clay or shale. During the period of metamorphism, however, there was probably also pneumatolitic and hydrolitic enrichment due to circulating gases and liquids, especially those bearing alumina.

The Carolina gneiss is usually a highly folded, much crumpled rock, and is said to be of Archaean age. It is interbanded with the Roan gneiss, a rock high in the ferromagnesian minerals, especially hornblende. The lenses of Carolina gneiss vary considerably in width, from a few inches to several hundred feet, and are sometimes several miles in length.

Distribution of Cyanite

The principal cyanite belt in North Carolina is confined principally to the north end of the Black Mountain range in Yancey county. The entire belt, however, extends from Mitchell county on the northeast to

the Georgia line on the southwest. It is said to extend 15 or 20 miles down into north Georgia. The total length of the belt is about 150 miles and the width seldom over five miles. The greatest width is probably reached in Buncombe and Haywood counties. Deposits of cyanite have been found in Wilkes, Iredell, Avery, Mitchell, Yancey, McDowell, Buncombe, Haywood, Madison, Jackson, Macon and Clay counties. The deposits are not continuous by any means over the above named counties, but occur in lenses seldom a mile in width and two or three miles in length. The deposits which offer the best opportunities for development occur near Burnsville, in Yancey county. The principal investigations so far have been confined largely to this district. However, some work has been done in Buncombe,

Mitchell, Clay and Iredell counties.

Types of Deposits

Cyanite occurs in two chief types of deposits: (1) disseminated in schists, (2) lenses or boulder-like masses. These two types, however, may be divided into sub-types, depending entirely on the nature of the formations, that is, whether hard or soft, percentages of associated minerals, etc.

The disseminated types of deposits are more common and so far examined offer the best advantages for development. The cyanite occurs in the schists as small tabular crystals varying in size from those barely discernible with the naked eye to those 2 in. or more in length, but are usually less than an inch in length. On the weathered surface of the schist the crystals stand out (See Fig. 1) due to their resistance to weathering. Where the rock mass has been entirely broken down, there are many small crystals of cyanite distributed over the surface and in the clay. It has been suggested that the cyanite could be recovered by hydraulic methods from this type of material, but so far no such deposits have been found which are large enough to warrant such treatment.

The cyanite crystals in the disseminated types of deposits are white, gray to bluish white, and are hard to distinguish from quartz without the aid of a lens. Dr. G. A. Bole, Ohio State University, noted this fact when he first visited the North Carolina deposits in 1927. On account of the color and the fineness of the crystals, it is impossible to estimate with any degree of accuracy the percentages of cyanite in the rock. When looking at the rock parallel to the crystals, due to the way that they stand, one is liable to overestimate the per cent, while looking at the rock at right angles to the crystals the opposite is true. It is only by actual separation that one can determine the amount of cyanite present.

The principal minerals associated with the cyanite in schist are, in order of importance, quartz, garnet, muscovite mica, biotite mica, sometimes graphite, hornblende, corundum,



Fig. 1. Specimen of schist showing arrangement of cyanite crystals, approximately natural size

and staurolite. All of the minerals, however, may or may not occur together. Sometimes the rock will run high in quartz and muscovite, with little or none of the other minerals; at others, high in garnet, and in some cases high in graphite, with little or none of the others.

The amount of cyanite in the rock mass varies from 2% to 28%, according to investigations made thus far, with an average of 10% to 15%. Even in the Carolina gneiss there are rich and lean streaks which give the rock a banded appearance. To determine the per cent of cyanite in any of the rock it is necessary to cross-cut the entire cyanite-bearing lens and make concentrating tests at 1-ft. intervals. Also, the weathered surface has to be taken off, because the cyanite crystals stand out and resist weathering more than the associated minerals.

The crystals of cyanite are more or less parallel with the planes of schistosity. Sometimes, however, they are interlocking, especially where the percentage of cyanite is high.

Relation to Quartz

In many of the larger crystals, quartz has replaced much of the cyanite, according to statements made by the parties investigating the cyanite, while Dr. Jasper L. Stuckey, of State College, Raleigh, states that the reverse is true; that is, the cyanite is replacing the quartz. He states that this has been his observation, because small pin-like crystals of cyanite penetrate the quartz. If circulating waters brought in alumina during the period of metamorphism, and if cyanite is a hydro-thermal mineral as Dr. Stuckey believes it is, then the cyanite has replaced the quartz. This holds true for a great per cent of the larger crystals.

Pure cyanite is said to carry 63% Al_2O_3 and 37% SiO_2 . On account of the replacement of the cyanite by quartz, or vice versa, the larger crystals have shown as low as 47% Al_2O_3 and more than 40% SiO_2 . The medium and small crystals of cyanite have shown as much as 66.5% Al_2O_3 .

In many of the larger crystals there are also small lenses of quartz which extend from one end to the other. Occasionally there are small crystals of garnet imbedded in the cyanite crystals which are not found at times until the crystals have been broken open. This is an exception rather than the rule. The occurrence of these tiny garnet crystals would also tend to lower the alumina content as well as to raise the silica content.

The depth to which the cyanite schist extends is not known, but it possibly reaches to 100 ft. or more, as some of the exposed cliffs are that high. It is possible that the entire tops of some of the mountains are composed of cyanite schist. There is apparently an unlimited supply of this type of material.

Lens Type of Deposits

The lens deposits of cyanite occur distributed intermittently throughout the whole cyanite belt. The largest deposit of this type observed so far is about 5 ft. wide and 100 ft. or more in length. However, fragments of similar material can be found for a distance of 500 yd. or more. Apparently these lenses are not continuous for any great distance, but can be traced intermittently for 10 or 12 miles. The depth of these lenses is problematical, but at one place a shaft 18 ft. in depth did not go through it.

The crystals of cyanite in the lenses or boulder-type formations sometimes reach a length of 6 or 7 in. and are from 1 to $1\frac{3}{4}$ in. in width and $\frac{1}{8}$ to $\frac{1}{2}$ in. in thickness. The crystals are sometimes interlocking, with no definite arrangement, while at others they seem to be more or less parallel. In some cases they have a sort of radial structure.

According to investigations made so far, none of the lens deposits are large enough

to offer commercial possibilities, in spite of the fact that a great number of such deposits have been examined and prospected. The largest deposits of this type known up to the present time occur in Buncombe, Mitchell, Clay and Wilkes counties. Neither are any of these deposits of such purity to be used without cleaning or concentrating.

Many of the lens deposits are said to be pure enough to be used commercially, but the chemical analysis will not bear out this statement. Several analyses have shown a low alumina content, a high silica, iron, sulphur, titanium, magnesium, or calcium content. On account of these impurities, leaching or concentrating methods, or both, will have to be adopted. Tests have shown that certain of the impurities are removed by leaching with various acids, especially sulphuric acid.

Analysis of Impurities

The iron occurs in the form of oxides and sulphides, especially pyrite and pyrrhotite; the titanium in the form of rutile; especially is this true in Clay county. Also it is believed that in certain localities the iron and titanium is in the form of ilmenite. The magnesium and calcium are in the carbonate form.

In some of the localities where the lens deposits outcrop above the surface, and especially where the crystals are crossed or interlocking, the pore spaces or cavities between the crystals are filled, or partially filled, with iron pyrites. Under no conditions could this type of material be used in the ceramic trade. At other times, however, there are voids with apparently little or no impurities.

If any of the lens deposits are opened up or attempted to be worked commercially, these facts will have to be guarded against, or at least taken into consideration. In some, even in very small, lens deposits the voids will be filled or partially filled with impurities, while only a few feet away in the same lens they are completely empty. From examinations and analyses made none of the lens material can be used as mined.

Pegmatite Veins

There is another occurrence of cyanite which will never be of commercial importance, but should be mentioned here. This type of occurrence has been noted at several localities. At the places where pegmatite dikes (both the true pegmatites, composed of quartz, feldspar and mica, and those which are composed essentially of quartz that may be classed as quartz veins)

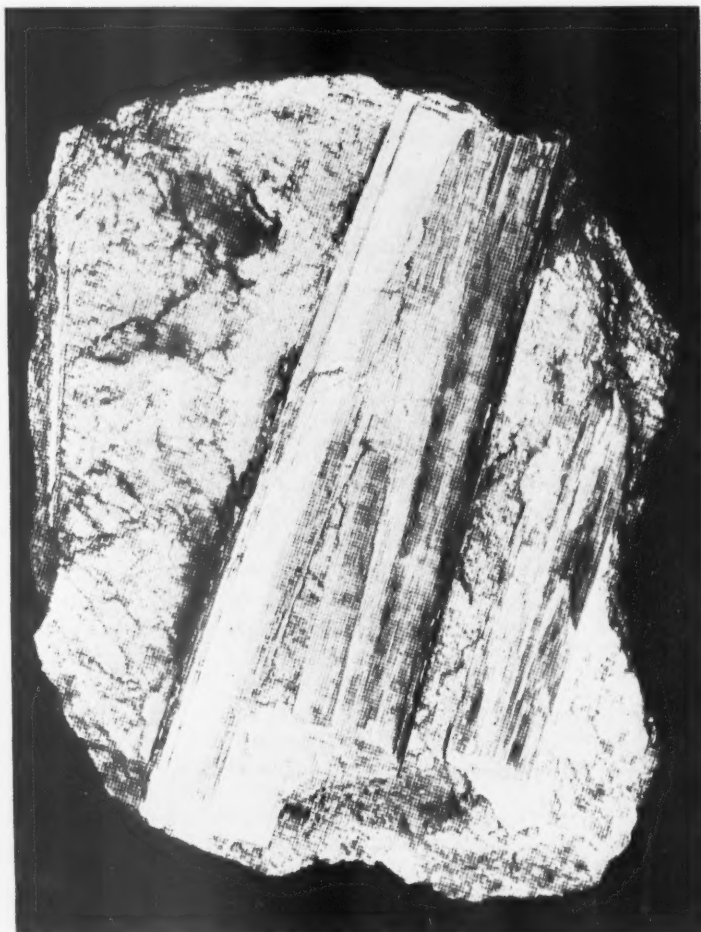


Fig. 2. Pegmatite showing large crystals of cyanite, approximately natural size

cut the cyanite schist there are extremely large crystals of cyanite imbedded in the dike material (Fig. 2).

Sometimes these tabular crystals are 10 or 15 in. in length, $1\frac{1}{2}$ to 2 in. in width, and from $\frac{1}{4}$ to $\frac{1}{2}$ in. in thickness. They make up from 15% to 25% of the rock mass, and along the contact between the dike and schist the dike material may run even higher in cyanite. Near the surface the material around the cyanite crystals is very friable and permits them to weather or spall out. Where this condition is found, large blue cyanite crystals occur scattered over the surface of the ground. Some of these crystals are suitable for gem purposes.

Several methods of concentration have been tried and tests have been carried on for several months. The principal methods tried are flotation, tabling, electromagnetic and electrostatic, but the final tests show that it will be a combination of two or more of these methods. Laboratory tests show that a very high grade material can be produced from the disseminated schists. It has also been shown that the material must be ground between 30 and 40 mesh to get the best results. When ground to this fineness, a higher per cent of recovery is obtained, as well as a cleaner product. The alumina content of this material runs as high as 66%.

Uses of Cyanite

Many of the uses of cyanite are questionable, but there is a possible use in a great many different ceramic bodies, especially refractory materials, as refractory brick and cements. Experiments and tests have been carried on to determine its value in the manufacture of the following materials: spark plugs, electrical porcelain, saggers, glass, chemical and china ware. The demand and future uses will depend entirely upon the amount of impurities present, the per cent of alumina, and the price per ton. If a high grade material can be produced and delivered at a reasonable price, that is, a price within the range of other ceramic materials, as feldspar, clay, etc., the future production and consumption should be large.

Summary

The mineral cyanite occurs in two chief types of deposits: (1) disseminated in schist; (2) and lens or boulder-like deposits. The mineral has long been considered as a metamorphic mineral, but recent observations show it to be possibly a hydrothermal mineral. The disseminated deposits which occur in the Carolina gneiss offer the best advantages for development. Tests show that a high grade material can be produced from the disseminated material.

Ground Freezing Areas Shown

AN ISOTHERMAL guide map for use in determining areas of the United States subject to ground freezing has been compiled by the Department of Agriculture from Weather Bureau records of 1929.

Causes of Death by Occupation

WORKERS TODAY may expect to live, on the average, five years longer than similar workers could in 1912, according to an analysis of mortality data revealed in Bulletin 507, U. S. Bureau of Labor Statistics. Statistics presented in this survey compared with the last report made in 1913 show some interesting facts.

Tuberculosis, nephritis, typhoid fever, cirrhosis of the liver, and suicide show a marked diminution. On the other hand, influenza, automobile accidents, cancer and homicide went up.

In the classification by industries cement and lime workers are nineteenth in the standardized relative index of some 75 industries for pneumonia. In the tuberculosis column, lime and cement workers show a lower ratio than the average, indicating that lime dust, like coal, has a protective action. These workers also have an excellent rating for diseases of the heart, fifty-seventh in the list. The industry rates high in accidental deaths, however, being eleventh.

Separation of Quartz and Feldspar by Flotation

QUARTZ AND FELDSPAR constitute a large part of the earth's crust and also are the most widely distributed of all minerals, says the United States Bureau of Mines. The uses of these minerals are almost innumerable and when pure, they are much sought for and command a relatively high price.

Feldspar and quartz not only occur contaminated with other minerals, but invariably are found together, generally quite intimately intermixed. These facts, especially the latter, account for the present market status of these minerals in spite of the universal distribution and unlimited quantities of the same.

Feldspar is obtained in commercial quantities from especially favored localities where certain portions of the earth's crust cooled very slowly, thereby causing the feldspar and also quartz to a lesser extent, to form in relatively large pure crystals. These large crystals of pure feldspar are hand picked from the mixture of minerals. At the present time this is our only source of pure feldspar. There is need, therefore, of a method of mechanical separation for treating the vastly larger supply of quartz-feldspar minerals, which at present cannot be hand picked because the component minerals are too finely dispersed. Hence a commercially feasible process for the separation of quartz and feldspar would not only reduce the present cost of feldspar, but would likewise also afford a supply of quartz, for in a general way, what has been stated concerning feldspar also applies to quartz. Therefore, an efficient mechanical method for the separation of quartz and feldspar would result in obtaining two useful commodities from an at present worthless material.

Moreover, if a commercially feasible process is devised for the separation of quartz and feldspar, it will have a direct bearing on the beneficiation of the non-ferrous base metal ores, due to the almost universal presence of quartz and feldspar as a worthless and objectionable dilutant in such ores.

In order to assist the mining industry to devise a commercially feasible process for the separation of quartz and feldspar, the Intermountain Experiment Station of the United States Bureau of Mines, in co-operation with the Department of Mining and Metallurgical Research of the University of Utah, Salt Lake City, Utah, has made a study of the problem, and as a result of the work that has been done, it is believed that a method has been devised which will meet the requirements. Moreover, in connection with the work, considerable data have been obtained which will be a distinct contribution to our present knowledge of flotation.

In connection with the work done by the Bureau of Mines, it was found that carefully controlled minute amounts of certain reagents would cause the feldspar particles to float and did not affect the quartz similarly. By this treatment 90% of the feldspar of a quartz-feldspar ore was floated and this flotation product contained more than 90% feldspar. The necessary quantities of the reagents range from a few hundredths to one-half pound per ton of ore. These reagents are all relatively inexpensive and are easily obtained.

Further work is to be done on this problem, and later the results will be published in the form of a Bureau of Mines technical paper.

Firms Maintain Scholarships

AMONG THE FIRMS listed in a compilation of scholarships and fellowships supported by industry issued by the National Research Council are:

Ash Grove Lime and Portland Cement Co., Kansas City, fellowship at Kansas State Agricultural College for research in cement and concrete, \$750.

Indiana Limestone Co., Bedford, Ind., research associate at Bureau of Standards for investigation of the physical properties of Indiana limestone.

Lone Star Cement Co., Dallas, Texas, fellowship at University of Texas for graduate study in the College of Engineering and the Bureau of Engineering Research, \$600. Lone Star Cement Co., New York City, fellowship at the Agricultural and Mechanical College of Texas for the study of the use of portland cement, \$600.

Portland Cement Association, Chicago, research associate at Bureau of Standards for investigating constitution of portland cement.

Trinity Portland Cement Co., Dallas, Texas, fellowship at the Agricultural and Mechanical College of Texas for study of the use of portland cement, \$600.

Limestone As a Filler in Phosphate Fertilizer*

Experiments Show Limestone Does Make a Good Filler

By E. L. Larison

Anaconda, Mont.

HIGH ANALYSIS PHOSPHATE FERTILIZERS containing around 45% available P_2O_5 or more are fast coming into use in many parts of the country. In many cases mixers find them the lowest cost phosphates they can buy for making up their own brands. It is often necessary in producing these brands to make use of a diluting material or filler. Suitable diluting material is not always easy to get and it has been found that in many localities the most suitable one is limestone. There has risen in the minds of some people the question as to whether or not ground limestone can be freely mixed with treble superphosphate without suffering reversion of available P_2O_5 to insoluble.

This question is the subject of this brief discussion.

It has been long recognized that in most soils available phosphates applied as fertilizers immediately come into contact with lime, iron, alumina, magnesia, etc. These bases are known to quickly fix the available phosphates into forms not water soluble at least, and in part usually not citrate soluble. This is clearly shown in the now well known fact that phosphate compounds penetrate soils only a few inches from where they were originally placed.

This fact is in most respects a fortunate one. Phosphates are not leached out and carried away out of range of the plants they are to serve, but remain substantially where placed. It is necessary, however, to place phosphates close to the plants to obtain prompt results.

The fixation of P_2O_5 by soil bases seems to have no bad effect upon actual availability to the plant. A clear demonstration of this fact is shown in results obtained by Purdue University Agricultural Experiment Station and reported by S. D. Conner in *The American Fertilizer* of April 12, 1930. These results indicate that there is in fact no reason why limestone should not be used as filler.

A very practical matter of difficulty might be considered still possible, i.e., the matter of analysis and maintaining guarantees. A series of mixtures of Anaconda treble superphosphate with ground limestone was made with the purpose of discovering the effect of limestone upon the condition of available P_2O_5 in the fertilizer plant.

The materials used were Anaconda treble

superphosphate ground to its usual fineness through a 6-mesh screen, and limestone of ordinary quality obtained from a quarry near Anaconda, Mont., ground to pass a 20-mesh screen.

The materials were carefully weighed and thoroughly mixed. The mixtures were allowed to stand in open containers protected from precipitation but subject to all changes of temperature and humidity during the spring of 1930.

The results follow:

ANACONDA TREBLE SUPERPHOSPHATE USED IN MIXTURES

Total	C. I.	Avail.	H ₂ O	W. S.
48.70	2.37	46.33	3.00	41.2

LIMESTONE USED IN MIXTURES

CaCO ₃	MgO	FeO	SiO	Al ₂ O ₃
88.5	.6	.6	7.4	1.2

No. 1—MIXTURE OF 1 PART SUPERPHOSPHATE WITH 3 PARTS GROUND LIMESTONE

	Total	C. I.	Avail.	H ₂ O	F. A.	W. S.
Theoretical	12.18	.59	11.59	.75	1.01	10.3
Immediate	12.10	.80	11.30	1.18	.16	7.9
30 days	12.60	.80	11.80	1.70	Nil	8.8
60 days	12.80	.81	11.99	.65	Nil	7.4
90 days	12.90	.94	11.96	1.55	Nil	6.0
Loss of available	—none.					

No. 2—MIXTURE OF 1 PART SUPERPHOSPHATE WITH 2 PARTS GROUND LIMESTONE

	Total	C. I.	Avail.	H ₂ O	F. A.	W. S.
Theoretical	16.23	.79	15.44	1.00	1.35	13.7
Immediate	17.00	1.00	16.00	1.70	.67	13.4
30 days	16.80	1.06	15.74	1.50	Nil	12.4
60 days	16.80	1.10	15.70	.45	Nil	9.3
90 days	16.60	1.43	15.17	2.00	Nil	6.4
Loss of available	—27%.					

No. 3—MIXTURE OF 1 PART SUPERPHOSPHATE WITH 1 PART GROUND LIMESTONE

	Total	C. I.	Avail.	H ₂ O	F. A.	W. S.
Theoretical	24.35	1.18	23.17	1.50	2.02	20.6
Immediate	24.20	1.47	22.73	1.70	.67	19.0
30 days	24.50	1.39	23.11	2.25	Nil	18.8
60 days	24.50	1.55	22.85	.50	Nil	16.0
90 days	24.40	1.56	22.84	2.55	Nil	13.3
Loss of available	—33%.					

No. 4—MIXTURE OF 3 PARTS SUPERPHOSPHATE WITH 1 PART GROUND LIMESTONE

	Total	C. I.	Avail.	H ₂ O	F. A.	W. S.
Theoretical	36.6	1.78	34.82	2.25	3.03	30.9
Immediate	37.5	2.19	35.31	2.25	1.83	29.2
30 days	35.5	2.00	33.50	2.63	.70	26.7
60 days	37.1	2.24	34.86	.40	.13	26.8
90 days	36.4	1.76	34.64	3.00	.08	27.1
Loss of available	—18%.					

It is to be noted that the assays are not entirely consistent, which is no doubt due to the difficulty to sampling mixtures of two

dissimilar materials. The series show the following points quite clearly:

1. Reversion of available P_2O_5 to insoluble form is so small as to be unimportant.

2. There is an almost complete elimination of free acids.

3. There is a marked decrease in water soluble and a corresponding increase in citrate soluble. This is more marked in the mixtures containing the larger proportions of limestones.

The conclusions which are logical from the above discussion are that limestone can be used as filler in any proportion wanted without decreasing the benefits of the phosphorus application; also that the amount of reversion of available P_2O_5 to citrate insoluble as shown by analysis is so small as to be of no practical importance.

The mechanical condition of the mixtures is improved by limestone and free acid is eliminated.

As a matter of fact several manufacturers have with complete success for the past two years used limestone as a filler in mixtures of treble superphosphate, potash salts and various nitrogenous materials.

Valuable Deposit in Louisiana

A SURVEY of the property of the Southern Mineral Co., near Windfield, La., made by Dr. Herbert M. Shilstone, reveals the fact that the company's limestone deposit covers a salt dome about 400 ft. down. The calcite cap goes 60 or 70 ft. Underneath is a stratum of gypsum, 25 to 30 ft. thick. Below this is a stratum of gypsum anhydrite, intermingled with pyrites and free sulphur. Then comes a deposit of rock salt which has been penetrated to a depth of 700 ft. without playing out. According to Dr. Shilstone, the limestone has been wasted, so far as its true value is concerned, as road material, as it is of unusually pure lime carbonate qualities.

40-Year-Old Concrete Is Found Watertight

AN EXAMINATION of the structure of the Crystal Springs Dam, which has been in service as part of the San Francisco water supply system since 1890, showed the concrete in perfect state of preservation.

*Reprinted from *The American Fertilizer*.

Researches on the Rotary Kiln in Cement Manufacture†

Part III.—The Correct Air Supply for Cement Rotary Kilns

By Geoffrey Martin

D.Sc. (London and Bristol), Ph.D., F.I.C., F.C.S., M. Inst. Chem. Eng., M. Inst. Struct. Eng., M. Soc. Pub. Analysts, F. Inst. Fuels; Chemical Engineer and Consultant; Former Director of Research of the British Portland Cement Research Association; Author of "Chemical Engineering"

FUEL ECONOMY in any branch of industry is usually applauded in theory but vehemently objected to in practice, for reasons which are many and complex, but which in the end are based on human frailty.

It is a startling commentary on this that a properly designed and properly worked cement rotary kiln employing the wet process (40% moisture in the slurry) can produce 100 tons* of cement clinker by the combustion in the kiln of 22 tons* of standard coal of 12,600 B.t.u. per lb. with a good normal output.

As the kilns are invariably improperly designed (or rather not designed at all—like Topsy, they simply "grew" to their present form and dimensions) and very badly worked, very few kilns consume less than 29 tons* of standard coal, and some run up to 45 tons* of standard coal per 100 tons* of cement produced.

The main cause of the high fuel consumption of the rotary kiln was discovered by the writer when director of research of the British Portland Cement Research Association in 1925, but as the remedy meant scrapping obsolete plants and building carefully designed, thermally efficient kilns, it has not been put into operation as yet, although the first steps have been taken and some economical kilns are now running.

A minor cause of high fuel consumption was found to be the wasteful admission of excess air into the kiln. We propose to deal with this aspect, and come on to the more complex causes in later installments.

The interesting point of the numerous scientifically accurate kiln tests carried out between 1917 and 1925 by the British Portland Cement Research Association was the revelation for the first time of the state of hopeless inefficiency of the whole industry and the urgent necessity for reform.

Among the mass of accurate experimental data accumulated were the records of 2139 analyses of the exit gases issuing from kilns working under all sorts of conditions.

I now propose to show how these records were utilized to discover the best amount of air to use for combustion in a rotary kiln,

Editor's Note

VISUAL control of burning, generally practiced, results in fluctuating air supply. Instrumental control is practicable, feasible and desirable. Tables and graphs can be computed for each installation, based on chemical facts and instrumental results, which will make possible scientific control of the air supply, thus insuring maximum possible efficiency. Thermodynamics of a cement kiln are worked out by practical examples.

and how they indicate what steps should be taken in order to effect a better control than has been possible up to date.

Let us first of all study the air supply of a modern rotary kiln and show its variations from minute to minute.

Fig. 1 (L30) is a record of the variations in the exit gas analyses of the Rhoose kiln, as shown by analyses taken every few minutes over several days.

The composition of the gas is never for a minute steady, but varies by a series of peaks followed by valleys.

The amount of air in this gas is followed by looking at the free oxygen curve, because every 1 volume of oxygen represents about 5 volumes of air. By following this oxygen curve you will see that we hardly ever have the correct amount of air present. We either have too much or too little, and the variations from too much to too little are sudden and abrupt.

Now what is the reason of this?

Constant Changing of Air Supply

You will at once see if you stand on the platform of the cement kiln and watch the burner. He uses his eye as an oxygen indicator. He first of all peers into the kiln, looking through a bit of blue glass, and he notes appearances which indicate to him that he is not supplying enough air. At once he alters the air valve, and usually now goes to the other extreme. He now lets in too much air. After a minute or two the effect of this policy begins to show itself in minute alterations in the appearance of the

white-hot material inside, and he then reverses the valve to reduce the air supply, again overshooting the mark. And so it goes on night and day in a cement kiln, a continuous variation of air supply which is never quite right.

Now I want to show you what a very bad state of affairs this is, and how we are losing valuable fuel all the time these variations in air supply are taking place. What we want is a steady flow of air and coal into the kiln, so that the composition of the exit gas does not alter appreciably from minute to minute, and under present conditions of burning I will show you that the free oxygen in the exit gas should remain constant at 1.1% by volume. With finer grinding of the coal and with more steady air control we might get below this, but things being as they are, this seems the correct percentage to use, as I will show in a few minutes. Admitting this for the moment, our exit gas analysis should show a steady curve when plotted against time, as shown in the dark line in Fig. 2. In studying the question of the correct air supply for a cement kiln, two main facts emerge:

If we use too small an amount of air with our coal we obtain incomplete combustion, and a gas called carbon monoxide (CO) is produced. This means a terrible waste of fuel. To every 1 lb. of carbon which escapes in the form of carbon monoxide (CO) there is associated a direct loss of no less than 10,231 B.t.u., and an even more serious indirect loss due to the lowering of the flame temperature with consequent loss of chemical potential, represented by what we will later call the amount of high-grade available heat. For the present we will deal only with the direct heat loss, which is quite serious enough in all conscience. The main facts are shown overleaf.

Loss of Heat Due to Incomplete Combustion

Composition of one coal:

Carbon = 72 lb.
Hydrogen = 5 lb.
Oxygen = 6 lb.
Ash = 17 lb.

100 lb.

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*Tons in every instance are British tons of 2240 lb. To convert to tons of 2000 lb. multiply by 1.12.

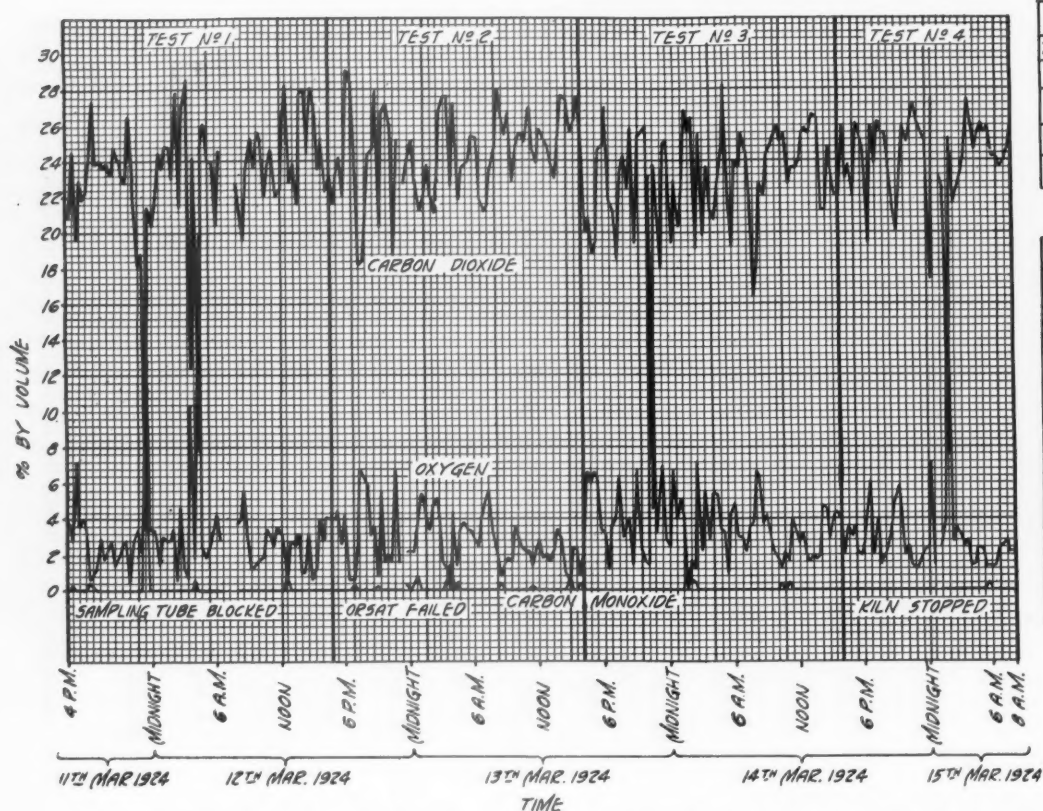
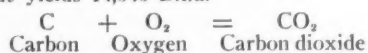


Fig. 1. Record of variations in the exit gas analyses taken every few minutes over several days

COMPLETE COMBUSTION (plenty of air). 1 lb. of carbon burning to carbon dioxide yields 14,646 B.t.u.



INCOMPLETE COMBUSTION (too little air). 1 lb. of carbon burning to carbon monoxide yields 4415 B.t.u.



HEAT LOSS ON INCOMPLETE COMBUSTION on each 1 lb. of carbon is 14,646 - 4415 = 10,231 B.t.u.

On the other hand, if we use too much air with the coal we get complete combustion, but we now waste heat in heating an unnecessary amount of gas to a high temperature, and also we lose chemical potential by depressing the flame temperature.

So that we have, so to speak, the danger of two evils—too little or too much air. Both produce a loss. What, then, is the right amount of air to use in the kiln?

In order to solve the problem, we must go back to experiment. As I mentioned before, we have in our records some 2139 analyses of exit gases coming from cement rotary kilns. Some years ago I discussed them—and it was a terrible bit of tedious labor to do this—and the result is shown in Table 1.

In considering this table you should carefully bear in mind that the results are statistical. To give an example of what I mean, look at column (1) and take the particular case where the free oxygen in the exit gas is shown as 0.000. Corresponding to this, you will see in column (2) the carbon monoxide is returned as 0.500. Now,

how were these numbers obtained? In this way: I went through all the exit gas analyses in which the free oxygen was returned as 0.000, and noted all the corresponding percentages of carbon monoxide. Next I added up all these percentages of carbon monoxide and divided the sum by the number of observations in which the free oxygen was put down as 0.000. I thus obtained the arithmetical average of the percentage of carbon monoxide corresponding to 0.000% of oxygen in the exit gas. The number came out as 0.500% of carbon monoxide when the free oxygen present in the exit gas was 0.000.

This process was repeated for all the various percentages of oxygen to be found in the exit gas analyses up to 10%, and in this way Table 1 was compiled.

The results are rather curious and are best exhibited graphically (Fig. 3).

You will see that the percentage of carbon

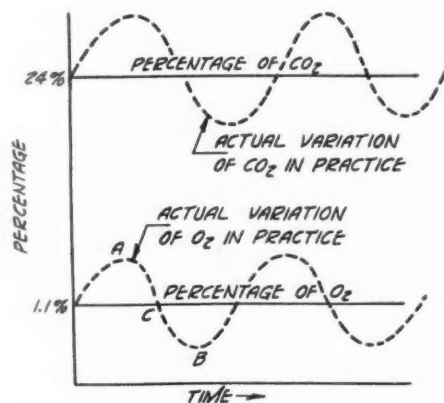


Fig. 2. Air supply as it should be, steady at 1.1% free oxygen

MAXIMUM CO ₂			MINIMUM CO ₂		
TEST	CO ₂	O ₂	CO	CO ₂	O ₂
1	28.4	0.6	0.0	3.4	13.0
2	29.0	0.7	0.1	18.2	6.8
3	28.2	1.0	0.0	4.6	20.0
4	27.4	1.4	0.0	7.6	18.4

MAXIMUM O ₂			MINIMUM O ₂		
TEST	CO ₂	O ₂	CO	CO ₂	O ₂
1	7.8	19.8	0.0	26.6	0.4
2	18.2	6.8	0.0	27.6	0.0
3	4.6	20.0	0.0	26.8	0.0
4	7.6	18.4	0.0	27.2	1.2

MAXIMUM CO			MINIMUM CO		
TEST	CO ₂	O ₂	CO	USUALLY NIL	
1	3.4	13.0	11.2		
2	27.6	0.0	1.4		
3	26.8	0.0	1.2		
4	25.6	1.4	0.4		

TABLE 1—SHOWING CONNECTION BETWEEN THE FREE OXYGEN, CARBON MONOXIDE AND LOSS OF FUEL DUE TO THE CARBON MONOXIDE IN ROTARY CEMENT KILN EXIT GASES

(1)	(2)	(3)
Average free oxygen in exit gas, % by volume	Average corresponding value of CO in exit gas, Per cent by volume	Pctg. fuel loss due to CO (tons* of coal lost per 100 tons* of standard coal fired)
A	B	B × 5.84
0.000	0.500	2.92
0.025	0.699	4.08
0.050	0.994	5.80
0.100	1.703	9.95
0.200	1.195	6.98
0.300	0.862	5.03
0.400	0.630	3.68
0.500	0.480	2.80
0.600	0.323	1.89
0.700	0.214	1.24
0.800	0.198	1.16
0.900	0.134	0.783
1.000	0.109	0.637
1.100	0.081	0.473
1.200	0.0685	0.400
1.300	0.0644	0.376
1.400	0.0611	0.357
1.500	0.0563	0.329
1.600	0.0511	0.298
1.700	0.0504	0.294
1.800	0.0476	0.278
1.900	0.0469	0.274
2.000	0.0441	0.257
2.100	0.0389	0.227
2.200	0.0366	0.214
2.300	0.0318	0.186
2.500	0.0290	0.169
3.000	0.0263	0.154
3.500	0.0183	0.107
4.000	0.0149	0.087
5.000	0.0118	0.069
6.000	0.0109	0.064
7.000	0.0078	0.046
8.000	0.0046	0.027
9.000	0.0000	0.000
10.000	0.0000	0.000

monoxide rapidly rises to a maximum, which is attained when the percentage of free oxygen reaches 0.1%, and thereafter steadily decreases. This is quite contrary to expectation, and at first sight indicates that if we reduced the free oxygen in the gas, matters would begin to improve as regards the quantity of the deleterious carbon monoxide present. This, of course, is a fallacious result, and is due to the fact that we are dealing with statistical quantities.

Where "Optical Control" of Burning Comes In

The result is, in fact, a good example of the old adage that a little knowledge is a dangerous thing. What the decrease really means is this: When the amount of air supplied becomes too small for the proper combustion of the coal (and as a consequence the amount of free oxygen in the exit gas begins to approach zero) there occur minute color changes in the flame of the burning powdered coal, which the burner recognizes. In general he is keeping a fairly careful watch on the flame, and he recognizes the symptoms some time before the percentage of free oxygen actually drops to zero. He counteracts this tendency by turning on too much air. What we see, therefore, is the effect of increasing the air supply by the burner before the limit is reached. The extra air now coming into the furnace starts combining with some of the carbon monoxide present, and thus diminishes its total value. In a way, therefore, the curve is a testimonial to the burners and shows that they are vigilant.

This maximum point, therefore, is due to

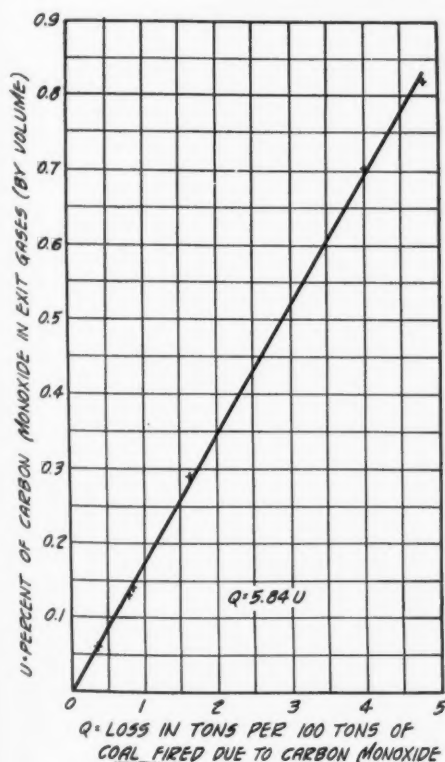


Fig. 4. Quarterly report of British Portland Cement Research Association showing fuel loss due to formation of carbon monoxide

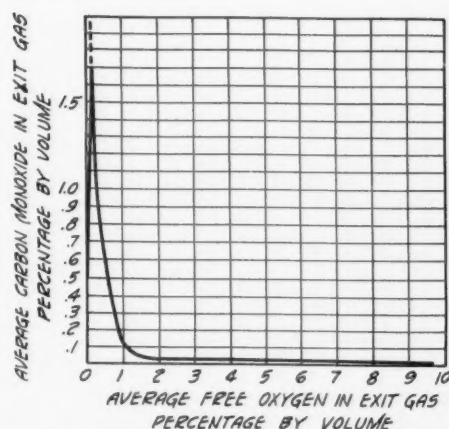


Fig. 3. Connection between the amount of free oxygen and carbon monoxide in flue gas

the human element controlling the furnace and is not a real natural effect. In general, as the amount of oxygen decreases the amount of carbon monoxide will increase, the curve of the carbon monoxide thus following the dotted line upwards.

Now it has been explained that in general whenever carbon monoxide is produced there is a serious loss of heat, amounting to over 10,000 B.t.u. per 1 lb. of carbon escaping as carbon monoxide (see Fig. 3).

Now, by a somewhat elaborate calculation which you will find set forth in the "Quarterly Report of the British Portland Cement Research Association for the Three Months Ending 31st December 1921," it is proved that if U be the percentage volume of carbon monoxide in the exit gas, the percentage fuel loss due to this carbon monoxide is $5.84 U$. That is to say, out of every 100 tons* of coal burnt the equivalent of $5.84 U$ tons* are wasted owing to the formation of carbon monoxide gas during combustion of the coal. Fig. 4 shows this.

Hence we are now in a position to obtain a relationship between the amount of free oxygen in the exit gas and the loss of fuel corresponding thereto owing to the formation of carbon monoxide. Table 1 will make this clear.

In column (1) is the percentage of free oxygen in the exit gas.

In column (2) is the corresponding percentage of carbon monoxide.

In column (3) is the corresponding loss of fuel, obtained by multiplying the percentage of carbon monoxide in column (2) by the factor 5.84, as explained above.

If we now plot column (1) against column (3), that is, the free oxygen in the exit gas against the fuel loss due to carbon monoxide, we obtain the curve shown in Fig. 5, which gives us the percentage loss of fuel due to carbon monoxide formation corresponding to any percentage of free oxygen present in the exit gas.

In order to avoid drawing false conclu-

*Tons in each instance are British tons of 2240 lb. To convert to tons of 2000 lb. multiply by 1.12.

sions, it should be carefully remembered that this is a statistical result and depends to some extent on the way the burners attend to the kiln and on the fineness to which the coal is ground.

In order that these precise numerical relationships should hold, the burners must continue to work as they worked during the tests, and the coal must continue to be pulverized in the same way.

If we alter our mode of working (i.e., our statistical conditions) in general, the curves will alter to some extent, the exact amount of which can only be settled by experimenting under the new conditions.

With this general proviso we may state, then, that in general, corresponding to any given percentage of free oxygen in the exit gas there corresponds a definite average loss of fuel due to the carbon monoxide present, and that the smaller the amount of free oxygen, the greater will be the loss of fuel due to carbon monoxide formation.

Loss of Fuel Due to Excess Air Present

We must now consider the loss of fuel occasioned by the air present in excess of that required for combustion of the coal. Obviously, the more air we have present in

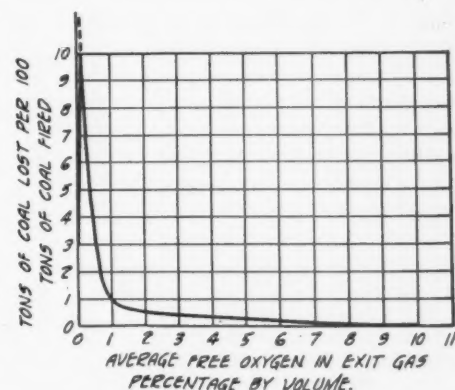


Fig. 5. Plotting column (1) of Table 1 against column (3) to secure connection between loss of fuel due to carbon monoxide and free oxygen in flue gas

the kiln, the greater the amount of heat that will be required in heating it to the temperatures prevailing inside the kiln. Because you cannot see the air, you must not consider it is not there. One cubic yard of air weighs about $2\frac{1}{4}$ lb. and requires about the same amount of heat to raise it to a given temperature as the same weight of clinker. In other words, the specific heat of clinker is about the same as that of air. You will see, therefore, that if you use more air than is required to burn the coal, you will have more waste gas to heat up to the temperature required for clinkering, and so you will be using valuable fuel for heating this air instead of producing clinker. Moreover, the presence of this excess air lowers the flame temperature of the burning coal and thus produces a loss of what is known as chemical potential, and this leads to a serious loss

of clinker, as becomes evident when we come to deal with flame temperatures.

Without considering this aspect of the case, we will here merely deal with the direct loss of B.t.u.'s which occurs in the kiln, which loss may be taken as equal to the amount of heat required to heat the air from that of the external atmosphere up to the exit temperature of the gas leaving the kiln. It is quite true that the excess air when it reaches the clinkering zone or in the decarbonating zone is at a considerably higher temperature than when it leaves the kiln, but as it passes down the kiln it parts with this extra amount of heat to the walls of the kiln and the raw material it meets on the way down. Fig. 6 will make this clear.

The air enters at A at a temperature of, say, 60 deg. F.; at B it attains a temperature of about 2800 deg. F.; but going down the kiln to C, it gives up much of its heat to the raw material, and its temperature steadily falls until it escapes at the end of the kiln at a temperature of, say, 800 deg. F. Hence in the long run the only loss of heat is the heat required to raise the temperature of the air from 60 to 800 deg. F., as indicated at D.

You will also see from this that the higher the exit temperature, the more serious will be the loss of heat. For example, if the exit temperature was 1000 deg. F. instead of 800 deg. F., the excess air would now be heated from 60 to 1000 deg. F. instead of to 800 deg. F., and obviously this requires more heat than before (Fig. 7).

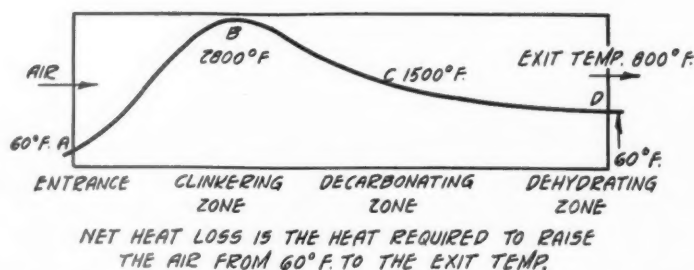


Fig. 6. How the temperature of the excess air varies in a kiln

Notice how rapidly the loss of heat increases with the exit temperature and how important it is from an economical point of view to keep the exit temperature as low as possible. Table 2 shows this in a somewhat more concrete form.

Loss of Fuel Due to the Combined Influence of the Carbon Monoxide and the Excess Air

In the preceding sections we first of all ascertained the fuel loss due to the formation of carbon monoxide considered as one factor. Then we ascertained the loss due to the excess air alone. We must now find out the combined loss due to both of these factors acting separately. You will see that we can now do this.

We have shown that, corresponding to any given percentage of free oxygen in our exit gas, we know the fuel loss appertaining to the carbon monoxide and also that appertaining to the excess air present. By adding these two losses we obtain the total fuel loss due to both causes acting together. Let us give an actual example.

Let us suppose that the free oxygen in the exit gas is 1.0%. Then from Table 1 we see

that the loss of coal due to the carbon monoxide is 0.6370 ton* of coal. Also from Table 2 we see that the fuel loss due to excess air present when the exit gas has 1.0% of free oxygen present is 0.3972 ton* when the exit gas temperature is 460 deg. F.

Hence the combined fuel loss due to both causes is: 0.6370 + 0.3972 = 1.0342 tons* of coal

per 100 tons* of standard coal burnt in the kiln.

By repeating this calculation for the different percentage values of the free oxygen in the exit gas, we arrive at the results shown in Table 3.

Fig. 8 shows the results plotted for three different exit temperatures, and you will see here again how important it is to keep the exit temperature as low as possible.

You will also notice the curious maximum point which is a statistical result due to the way the burner works the kiln by letting in excess air when the air supply becomes too small, as I explained before when dealing with the results for carbon monoxide. The minimum point occurs when the percentage of free oxygen in the exit gas has the value of 1.1%.

We have thus arrived at the very important result that the best proportion of air to use is such as to yield an exit gas containing 1.1% of free oxygen in it. It must be carefully remembered that this also is a statistical result, and depends upon the assumption that the kilns continue to be worked in the

*Tons in each instance are British tons of 2240 lb. To convert to tons of 2000 lb. multiply by 1.12.

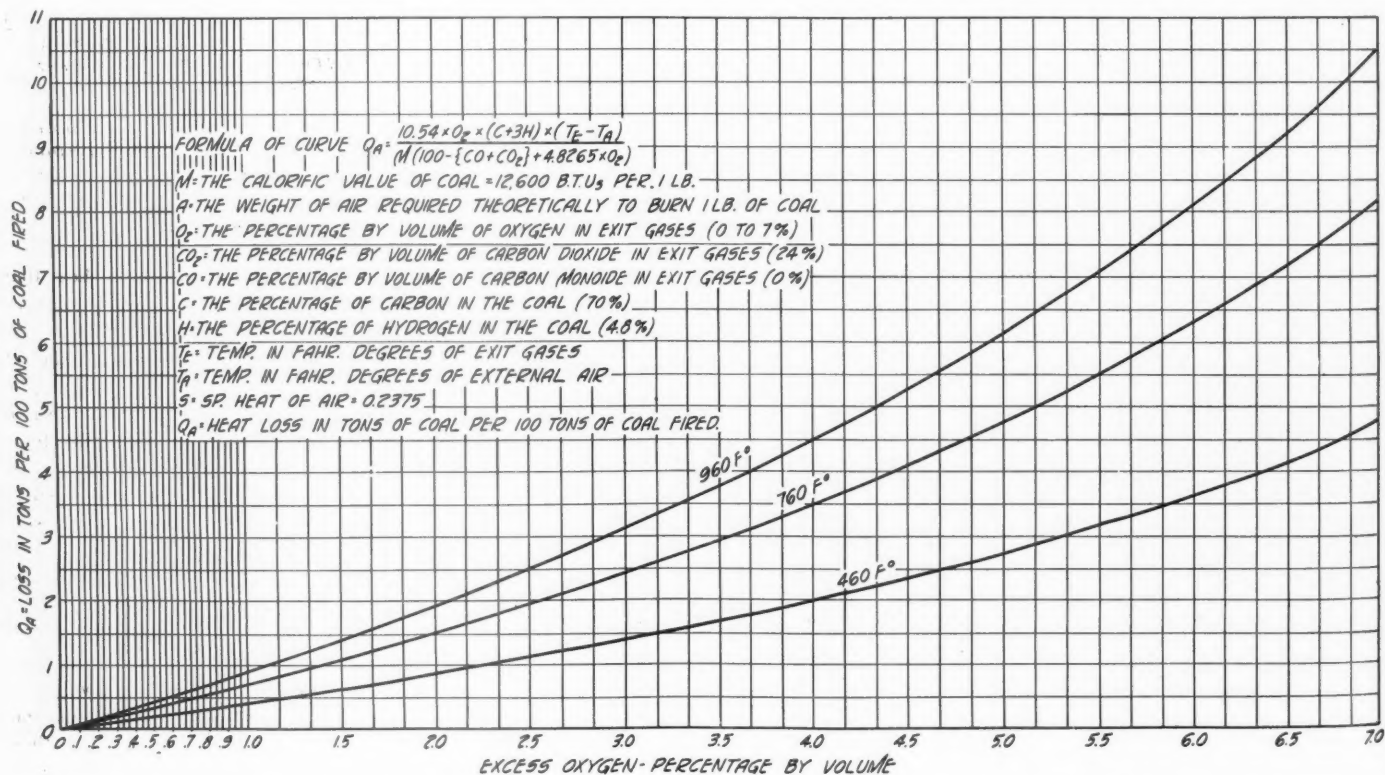


Fig. 7. Curve showing loss of coal due to heating excess air. From a quarterly report of British research bureau

TABLE 2—TONS* OF COAL CONSUMED IN HEATING EXCESS AIR PER 100 TONS* OF COAL BURNT IN THE FURNACE
(Standard coal calorific value, 12,600 B.t.u. per lb.)

(1) Per cent. O ₂ in volume in exit gases	(2) Temp. of exit gases (deg. F.) 460 deg. Tons*	(3) Temp. of exit gases (deg. F.) 760 deg. Tons*	(4) Temp. of exit gases (deg. F.) 960 deg. Tons*
0.1	0.0364	0.0712	0.08461
0.2	0.0752	0.1321	0.1692
0.3	0.1135	0.1992	0.2560
0.4	0.1527	0.2672	0.3425
0.5	0.1919	0.3353	0.4313
0.6	0.2322	0.4055	0.5242
0.7	0.2724	0.4767	0.6129
0.8	0.3126	0.5489	0.7058
0.9	0.355	0.6213	0.7986
1.0	0.3972	0.6942	0.8925
1.1	0.4396	0.7262	0.9884
1.2	0.4829	0.845	1.085
1.3	0.5262	0.9214	1.184
1.4	0.5765	1.000	1.286
1.5	0.6221	1.090	1.400
1.6	0.6614	1.157	1.489
1.7	0.7078	1.239	1.594
1.8	0.7553	1.322	1.699
2.0	0.8512	1.490	1.916
2.5	1.114	1.949	2.507
3.0	1.377	2.410	3.100
3.5	1.672	2.927	3.763
4.0	1.993	3.488	4.483
4.5	2.342	4.097	5.268
5.0	2.724	4.767	6.130
6.0	3.604	6.304	8.110
7.0	4.685	8.198	10.55

TABLE 3—TOTAL LOSS OF STANDARD COAL IN TONS* PER 100 TONS* BURNT IN FURNACE, DUE TO COMBINED INFLUENCE OF EXCESS AIR AND CARBON MONOXIDE IN THE EXIT GASES OF A ROTARY CEMENT KILN

Average excess oxygen, per cent. by volume	Temp. of exit gases (deg. F.) 460 deg. Tons*	Temp. of exit gases (deg. F.) 760 deg. Tons*	Temp. of exit gases (deg. F.) 960 deg. Tons*
0.0	2.92	2.92	2.92
0.1	9.98	10.01	10.02
0.2	7.06	7.11	7.15
0.3	5.15	5.23	5.28
0.4	3.83	3.95	4.02
0.5	2.57	2.71	2.81
0.6	2.12	2.30	2.41
0.7	1.53	1.72	1.86
0.8	1.47	1.70	1.86
0.9	1.14	1.40	1.58
1.0	1.03	1.33	1.52
1.1	0.91	1.20	1.46
1.2	0.88	1.24	1.48
1.3	0.90	1.30	1.56
1.4	0.93	1.36	1.64
1.5	0.95	1.42	1.73
1.6	0.96	1.45	1.78
1.7	1.00	1.53	1.88
1.8	1.00	1.60	1.97
2.0	1.10	1.74	2.17
2.5	1.28	2.12	2.67
3.5	1.78	3.03	3.87
4.0	2.08	3.57	4.57
5.0	2.80	4.83	6.19
6.0	3.67	6.36	8.17
7.0	4.73	8.24	10.57

same way as heretofore by the burners, and also that the coal continues to be ground to about the same degree of fineness. If alterations in these basic procedures take place, no doubt alterations in the concomitant statistical figures will result, which would have to be redetermined by a fresh set of observa-

tions made under the new conditions.

QUESTIONS OF THE STEADINESS OF AIR SUPPLY. Now let us go back to the question of the steadiness of the air supply and consider it in the light of the preceding remarks. You will remember that matters are so worked by the burner that he

has always too much or too little air passing into the kiln, but never the exactly correct amount.

Now refer to Fig. 2. When the excess oxygen is too much, as at *A*, he is wasting fuel, and when the excess air is too little, as at *B*, he is again wasting fuel. It is obvious, then, that the correct thing is for the supply of air to be steady in respect to coal so as to maintain the exit gas oxygen at about 1.1%. Even if the burner arranges a series of fluctuations of air so as to maintain the average exit oxygen about right, this is not the correct thing to do, as his flame temperature will be lowered and a certain fuel wasteage will occur all the same.

Hence the correct thing to do is to eliminate all fluctuations in the exit oxygen by insuring a steady air supply in respect to the coal. How can we achieve this?

HOW TO OBTAIN A STEADY AIR SUPPLY. In order to obtain steadiness in the air supply we must help the burner. He now depends upon his eye alone, and is surprisingly accurate. Nevertheless, you saw the fluctuations he makes. How, then, are we to help him?

Now, the burner is obviously a very important man in a works. He may be likened to the driver of a motor car. What do we do with the driver of a motor car costing, say, \$2500? We give him all sorts of instruments to guide him. He has a little mirror to show him who is coming behind, then he is given a speedometer to tell him how fast he is going, also voltmeters, gasoline gages, brakes, horns and all sorts of gadgets. A motor car driver, then, is well provided

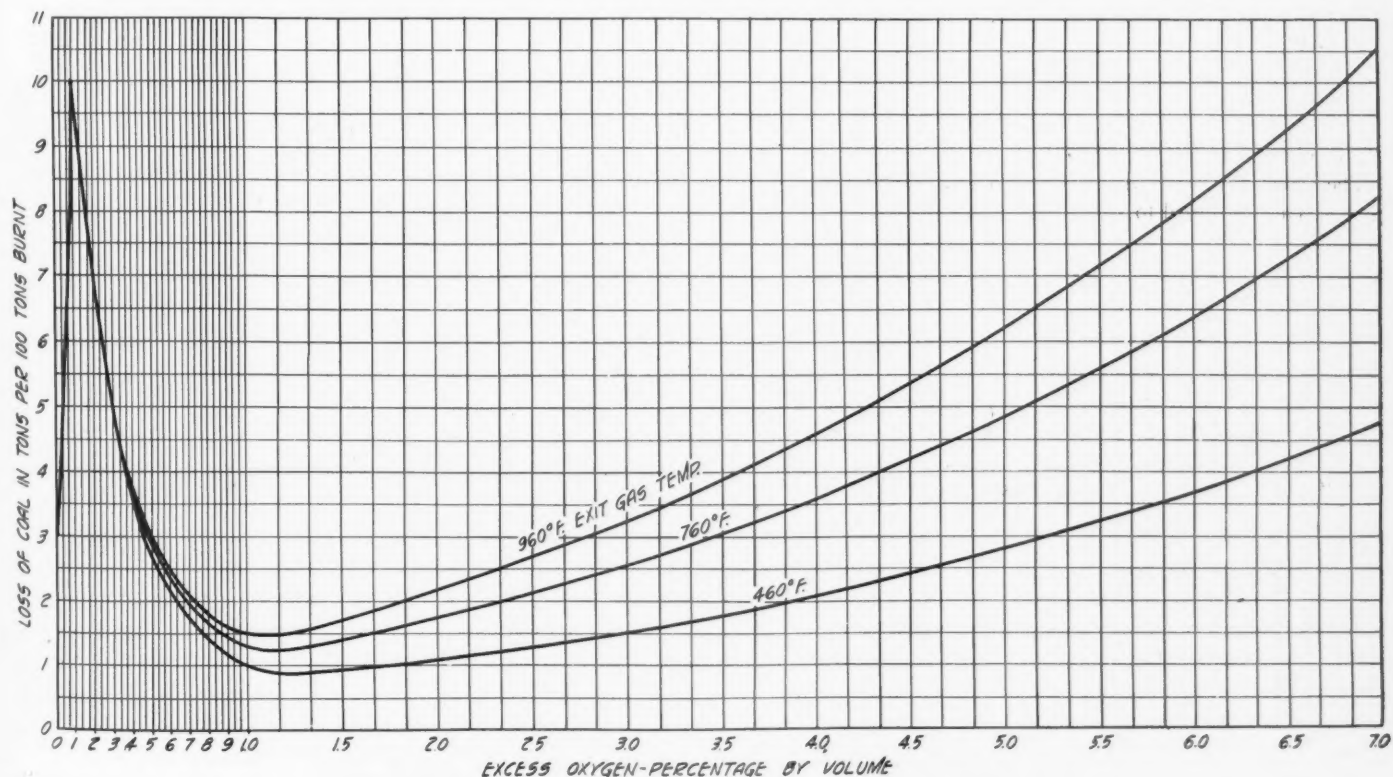


Fig. 8. Total loss of standard coal in tons* per 100 tons* burned in kiln due to the combined influence of excess air and carbon monoxide at three different exit gas temperatures

for. What about the driver of a large kiln costing, say, \$100,000 and burning many hundreds of tons of coal a week? All the average poor burner gets is a bit of blue glass, which is a very crude instrument. In fact, the burner is the most neglected man on a works, whereas he should be most carefully provided with instruments for aiding him in gaging accurately the correct air supply. This brings us to the question of suitable instruments.

The present instruments in use do not reach the burner. They are kept carefully locked up in a glass case, which every now and again are inspected by a high official, but I do not think the burner regards them otherwise than with suspicion and dislike. They are no help to him, though they may indicate to the manager how in general the kiln is run.

In general what the burner wants is an instrument which indicates to him from second to second the oxygen content of the exit gases, so that without leaving his position for a moment he can at once correct his supply with a simple turn of a handle just as a driver of a motor car can regulate his speed from second to second by looking at his instruments. Fig. 9 is a diagrammatic sketch of the type of arrangement that I mean.

On the burner's platform, in a position that he can see from a distance, is an indicator which moves up and down a scale and indicates from second to second the oxygen content of the exit gas. When the indicator gets below a position indicating less than 1% of oxygen in his exit gas, a bell rings indicating danger, and the same applies when the oxygen content rises beyond 2%. The job of the burner is to keep the air supply as steady as possible, so that in respect to the coal the exit gas has a uniform, steady oxygen content of 1.1%.

The writer has designed a recorder of this type which when fitted to an ordinary 200-ft.

cement kiln will regularly save from 50 to 150 tons* of coal per week—according to the degree of prevailing mismanagement—and in many cases enable an increase of output of 10% to 40% per week to be attained.

Appendix I

DEDUCTION OF A GENERAL FORMULA FOR CALCULATING THE LOSS OF FUEL DUE TO THE PRESENCE OF CARBON MONOXIDE GAS IN THE EXIT GAS FOR CEMENT KILNS. When 1 lb. of carbon is burned to carbon monoxide it produces 4415 B.t.u., whereas when burnt to carbon dioxide it produces 14,646 B.t.u. (Kershaw, "Fuel, Water, and Gas Analysis," 1919, p. 178).

Hence for every 1 lb. of carbon escaping in the form of carbon monoxide there occurs the very serious loss of

$$14,646 - 4415 = 10,231 \text{ B.t.u.}$$

Let Q = loss in tons* of coal per 100 tons* of coal fired owing to presence of carbon monoxide.

N = the number of tons* of standard coal (12,600 B.t.u. per lb.) consumed in making 100 tons* of clinker, carbon monoxide being present in the exit gas, i.e., combustion is incomplete.

N_1 = the standard coal consumption per 100 tons* clinker which would have occurred if no carbon monoxide had been present in the exit gases, i.e., if combustion had been perfect.

P = the percentage of CaCO_3 in the dried slurry.

C = the clinker output in tons* per hour.

X = the weight of coal fired in the kiln in tons* per hour.

Y = the percentage of carbon in the coal used.

U = the percentage of CO by volume present in the exit gases.

V = the percentage of CO_2 by volume present in the exit gases.

M = the calorific value of the fuel in B.t.u. per lb.

L = the loss of heat in B.t.u. per lb. of carbon burnt to carbon monoxide.

We take $L = 10,231$ B.t.u. per 1 lb. carbon escaping as CO.

Then

$$Q = \left[1 + \frac{12P \cdot C}{(100 - 0.44P)XY} \right] \cdot \frac{\frac{L}{U} \cdot \frac{Y}{11}}{M \cdot \frac{U+V}{1} \cdot \frac{1}{7}} \quad (1)$$

When the quantities which occur in average cement rotary kilns are inserted in (1), it simplifies to the approximate formula:

$$Q = 5.84U \quad (1a)$$

These formulæ are deduced as follows:

AMOUNT OF CARBON DIOXIDE FROM SLURRY DURING CLINKER FORMATION. From the equation $\text{CaCO}_3 = \text{CaO} + \text{CO}_2$ it will be seen that on ignition 100 parts of CaCO_3 lose 44 parts of CO_2 , or P parts of CaCO_3 lose $0.44P$ parts of CO_2 . But 100 parts of dry slurry contain P parts of CaCO_3 , so that 100 parts of dry slurry when heated lose $0.44P$ parts of CO_2 and yield $100 - 0.44P$ parts of clinker, i.e., $(100 - 0.44P)$ tons* of clinker are attended with the evolution of $0.44P$ tons* of CO_2 .

Hence C tons* of clinker produced are attended with the evolution from the slurry of

$$W_1 = \frac{0.44P \cdot C}{100 - 0.44P} \text{ tons* of } \text{CO}_2 \quad (2)$$

W_1 represents the number of tons* of CO_2 produced per hour in the furnace evolved from the slurry when C tons* of clinker are formed.

AMOUNT OF CARBON DIOXIDE FROM COMBUSTION OF COAL. From the equation $\text{C} + \text{O}_2 = \text{CO}_2$ it will be seen that 1 ton* of free carbon completely burnt yields $12 + 32 = 44$

$$\frac{44}{12} \text{ tons* of } \text{CO}_2.$$

In 100 tons* of coal there are Y tons* of carbon; 100 tons* of coal burnt represent $\frac{44}{12}Y$ or $\frac{11}{3}Y$ tons* of carbon dioxide produced.

Hence, if W_2 represent the weight in tons* of CO_2 produced per hour in the kiln by the combustion of the coal, and X be the number of tons* of coal fired in the kiln per hour, then

$$W_2 = \frac{11}{300} \cdot X \cdot Y \text{ tons*} \quad (3)$$

RELATIVE WEIGHTS AND VOLUMES OF CARBON DIOXIDE PRODUCED FROM COAL AND SLURRY RESPECTIVELY, WHICH OCCUR IN THE EXIT GASES OF A CEMENT ROTARY KILN. If W be the total number of tons* of carbon dioxide produced in the kiln per hour, W is made up partly of carbon dioxide arising from the decomposition of the slurry during the clinker production

*Tons in each instance are British tons of 2240 lb. To convert to tons of 2000 lb. multiply by 1.12.

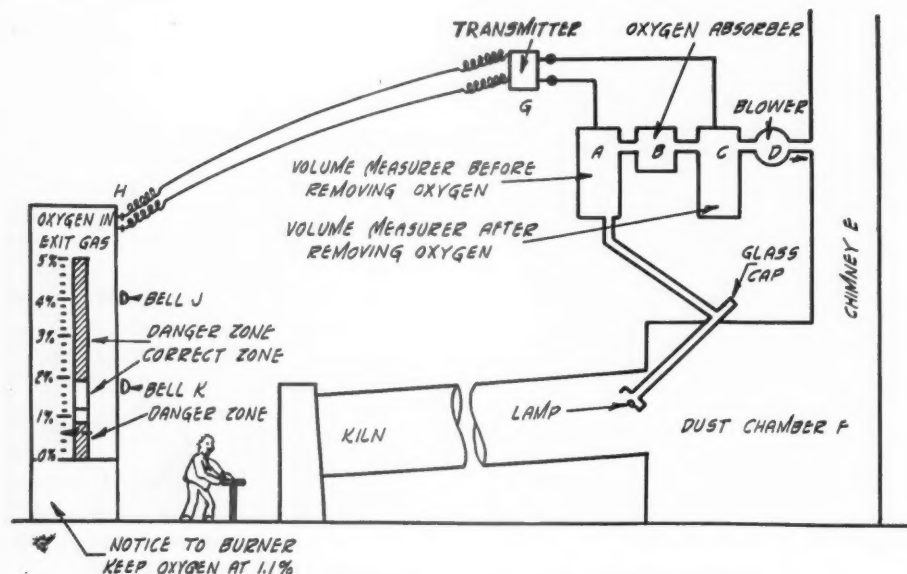


Fig. 9. Dr. Martin's arrangement for air control

and partly from the combustion of the coal fired.

$$\text{Hence } W = W_1 + W_2 \\ \text{or } W = \frac{0.44P \cdot C}{100 - 0.44P} + \frac{11}{300} \cdot X \cdot Y \quad (4)$$

Out of the total W tons* of carbon dioxide in the exit gases, W_2 tons* are due to coal alone.

So that for every unit weight of carbon dioxide in the flue there are $\frac{W_2}{W}$ units due to coal.

But the weights are directly proportional to the volumes. So that out of every 1 volume of CO_2 in the exit gases, $\frac{W_2}{W}$ volumes are due to coal.

Since 1 volume of carbon monoxide in burning produces an equal volume of carbon dioxide, it follows that if combustion had been complete the percentage volume of CO_2 in the exit gases would have been $(U + V)$ per cent., where U = the actual per cent. of CO , and V = per cent. of CO_2 in the exit gases, and of this the proportion due to coal alone is $(U + V) \cdot \frac{W_2}{W}$.

Hence we have the following relationship:

$$(U + V) \cdot \frac{W_2}{W} \text{ per cent. by volume of } \text{CO}_2$$

in the exit gases corresponds to

$$(U + V) \cdot \frac{W_2}{W} \times \frac{12}{44} \text{ lb. of carbon burnt,} \\ \text{i.e., to } (U + V) \cdot \frac{W_2}{W} \times \frac{12}{44} \times \frac{100}{y} \text{ lb. of}$$

$$\text{coal burnt,} \\ \text{i.e., to } (U + V) \cdot \frac{W_2}{W} \cdot \frac{12}{44} \cdot \frac{100}{y} \cdot M \text{ B.t.u.}$$

evolved,

where M is the calorific value of the coal in B.t.u.'s per lb. on the same proportional scale:

$$U \text{ per cent. by volume in the exit gases} \\ \text{corresponds to } U \cdot \frac{12}{28} \text{ lb. of carbon burnt to}$$

$$\text{CO, i.e., to a loss of } L \cdot U \cdot \frac{12}{28} \text{ B.t.u. owing} \\ \text{to the formation of carbon monoxide, } L \text{ being the loss in B.t.u.'s when 1 lb. of carbon burns to CO instead of to } \text{CO}_2.$$

We have seen that $L = 10,231$ B.t.u.

Hence out of a total possible heat evolution of

$$(U + V) \cdot \frac{W_2}{W} \cdot \frac{12}{44} \cdot \frac{100}{y} \cdot M \text{ B.t.u. there are} \\ \text{lost on account of CO formation the amount of}$$

$$L \cdot U \cdot \frac{12}{28} \text{ B.t.u.}$$

So that out of a possible 100 B.t.u. evolved there are lost

$$Q = \frac{W}{W_2} \cdot \frac{L}{M} \cdot \frac{U}{U + V} : Y \cdot \frac{11}{7} \text{ B.t.u.} \quad (5)$$

or substituting the values of W and W_2 from (3) and (4).

This reduces to

$$Q = \left[1 + \frac{12P \cdot C}{(100 - 0.44P) \cdot X \cdot Y} \right] \\ \cdot \frac{L}{M} \cdot \frac{U}{U + V} \cdot Y \cdot \frac{11}{7} \text{ B.t.u.}$$

Again, since 100 tons* of fuel lose Q tons due to carbon monoxide formation, the loss on N tons* (where N is the standard coal consumption per 100 tons* of clinker produced) is $N \cdot \frac{Q}{100}$; or the corrected standard consumption is

$$N_1 = N - \frac{NQ}{100},$$

$$\text{or } N_1 = N \frac{(100 - Q)}{100} \quad (6)$$

N_1 is the smaller standard coal consumption which would have been attained if no thermal losses due to the formation of CO had occurred, i.e., if combustion had been perfect.

APPLICATION OF FORMULA TO KILN TESTS. The following table of data compiled from actual tests make it possible to calculate the percentage loss of fuel Q due to the formation of carbon monoxide, and also to calculate N_1 , the corrected fuel consumption. The results are shown in Table 3.

TABLE III—ROTARY KILN RESEARCH

	Symbol	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Clinker output per hour, tons*	C	7.60	4.27	5.00	5.26	4.935	4.36
Coal as fired per hour, tons*	X	2.280	1.221	1.717	1.590	1.580	1.246
Standard coal consumption per 100 tons* clinker	N	30.7	29.7	34.1	32.6	33.8	30.6
Calorific value of coal as fired, B.t.u.'s per lb.	M	12,880	13,108	12,500	13,590	13,300	13,500
Per cent. C in coal	Y	70.61	70.61	73.39	70.61	69.66	70.61
CaCO_3 in dry slurry	P	77.6	76.18	76.2	76.0	76.1	76.3
Analysis of exit gas per cent. by volume CO_2	V	23.8	24.1	24.05	23.88	23.79	24.32
Analysis of exit gas per cent. by volume CO	U	0.13	0.14	0.82	0.72	0.29	0.06
Analysis of exit gas per cent. by volume O_2		1.64	0.88	0.24	0.19	0.23	0.36

$$\text{Substituting these values in the formula } Q = \left[1 + \frac{12P \cdot C}{(100 - 0.44P) \cdot XY} \right] \\ \cdot \frac{L}{M} \cdot \frac{U}{U + V} \cdot \frac{Y}{1} \cdot \frac{11}{7} \text{ and } N_1 = \frac{(100 - Q)}{100} \text{ we get the following results:}$$

	Symbol	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
Loss per 100 tons* of coal burnt due to CO tons*	Q	0.7984	0.8394	4.806	4.01	1.629	0.348
Standard coal consumption per 100 tons* clinker if no losses had occurred	N_1	30.46	29.46	32.46	31.3	33.28	30.5
Actual standard coal consumption in presence of CO	N	30.70	29.70	34.10	32.6	33.80	30.6
Loss in standard coal per 100 tons* clinker due to CO tons*		0.24	0.24	1.64	1.3	0.52	0.1

On tabulating the percentage U of CO in the exit gases against Q , the percentage loss of fuel, we get the following table:

Volume per cent. $\text{CO} = U = 0.06$	0.13	0.14	0.29	0.72	0.82
Per cent. loss fuel = $Q = 0.346$	0.7984	0.8394	1.639	4.01	4.806
$\frac{Q}{U} = 5.80$	6.141	5.996	5.654	5.57	5.86

The average value of $\frac{Q}{U}$ is 5.84, whence

$$Q = 5.84 U \quad (1a)$$

This is the formula given above as applicable to cement rotary kiln practice.

Fig. 4 shows the loss in tons* per 100 tons* of coal burnt plotted against the percentage of carbon monoxide in the flue gases. It will be noticed that the result is nearly, but not quite, a straight line.

It will be noticed that the loss increases very rapidly with the percentage of carbon monoxide, e.g., a loss of 5% on firing coal occurs when 0.85% CO is present in exit gas.

Appendix II

GENERAL FORMULA FOR CALCULATING THE LOSS OF FUEL DUE TO EXCESS AIR IN ROTARY KILNS.

Let M = the calorific value of the coal used in B.t.u. per lb.

A = weight of air required theoretically to burn 1 lb. of coal.

O_2 = per cent. by volume in exit gases of oxygen.

CO_2 = per cent. by volume in exit gases of carbon dioxide.

CO = per cent. by volume in exit gases of carbon monoxide.

N_2 = per cent. by volume in exit gases of nitrogen.

C = per cent. of carbon in coal.

H = per cent. of hydrogen in coal.

T_R = temperature in Fahrenheit degrees in exit gases.

T_A = temperature in Fahrenheit degrees of external air.

S = specific heat of air, here taken as 0.2375.

Q_A = the number of tons* of fuel per 100 tons* of fuel burnt in the furnace which are wasted in heating the excess air present to the exit gas temperature.

$$\text{Then} \\ Q_A = \frac{10.54 \cdot \text{O}_2 \cdot (C + 3H) \cdot (T_R - T_A)}{M[100 - (\text{CO} + \text{CO}_2 + 4.8265 \cdot \text{O}_2)]}$$

*Tons in each instance are British tons of 2240 lb. To convert to tons of 2000 lb. multiply by 1.12.

WEIGHT OF AIR REQUIRED TO BURN 1 LB. OF COAL. If 100 lb. of coal contain C lb. of carbon and H lb. of combustible hydrogen, and if the air is taken as containing 23% of oxygen by weight, then from the equations



it is deduced that the weight of air required to burn C lb. of carbon is $C \cdot \frac{32}{12} \cdot \frac{100}{23}$, and the weight of air required to burn H lb. of hydrogen is $H \cdot 8 \cdot \frac{100}{23}$.

Hence the weight of air required to burn 100 lb. of coal is

$$C \cdot \frac{32}{12} \cdot \frac{100}{23} + H \cdot 8 \cdot \frac{100}{23} = 11.595 (C + 3H) \text{ lb.}$$

or the weight of air required to burn 1 lb. of coal is given by

$$A = 0.11595 (C + 3H) \text{ lb.} \quad (1)$$

CONNECTION BETWEEN WEIGHT OF AIR UNITING WITH THE COAL AND WEIGHT OF EXCESS AIR SUPPLIED. From analysis:

O₂ volumes of oxygen and N₂ volumes of nitrogen are present in 100 volumes of exit gases.

By Avogadro's law the weights of the volumes of two gases are in the proportion O₂ × 32 to N₂ × 28. Now N₂ × 28 lb. of nitrogen correspond to $(N_2 \times 28) \cdot \frac{100}{77}$ lb. of air originally delivered, and O₂ × 32 lb. of oxygen correspond to $(O_2 \times 32) \cdot \frac{100}{23}$ lb. of excess air originally delivered.

Hence, out of $(N_2 \times 28) \cdot \frac{100}{77}$ lb. of air originally delivered to the furnace there were $(O_2 \times 32) \cdot \frac{100}{23}$ lb. of air in excess of that theoretically needed to burn the coal, i.e., out of every 1 lb. of air originally supplied, $\frac{O_2}{N_2} \cdot \frac{32}{28} \cdot \frac{77}{23} = 3.8265 \cdot \frac{O_2}{N_2}$ lb. are in excess of that required to burn the coal. Hence to every $\left[1 - 3.8265 \cdot \frac{O_2}{N_2}\right]$ lb. pass away with excess air, i.e., to every 1 lb. of air which unites with the coal,

$$\frac{3.8265 \cdot \frac{O_2}{N_2}}{1 - 3.8265 \cdot \frac{O_2}{N_2}} \text{ lb.}$$

of excess air pass away uselessly.

HEAT LOSS IN HEATING EXCESS AIR. From the preceding result it follows that since 1 lb. of coal in burning unites with $A = 0.11595 (C + 3H)$ lb. of air, the excess

air present when 1 lb. of coal burns completely is

$$0.11595 (C + 3H) \times \frac{3.8265 \cdot \frac{O_2}{N_2}}{1 - 3.8265 \cdot \frac{O_2}{N_2}} = \frac{0.4437 \cdot (C + 3H) \cdot \frac{O_2}{N_2}}{1 - 3.8265 \cdot \frac{O_2}{N_2}}$$

Now, when 1 lb. of coal burns completely, there is evolved M B.t.u., and of this heat the amount used for heating the excess air is

$$\frac{0.4437 \cdot (C + 3H) \cdot \frac{O_2}{N_2}}{1 - 3.8265 \cdot \frac{O_2}{N_2}} \times S \times (T_E - T_A),$$

where S = specific heat of the air = 0.2375.
 T_E = temperature degree of exit gases.
 T_A = temperature degree of external air.

That is, out of every 100 B.t.u.'s of heat evolved, there are wasted in heating the excess air

$$0.4437 (C + 3H) \cdot \frac{O_2}{N_2} \cdot S \cdot (T_E - T_A) \cdot 100$$

$$M \left[1 - 3.8265 \cdot \frac{O_2}{N_2} \right]$$

Now, the heat evolved is proportional to the weight of coal burnt. Hence it follows that if Q_A represents the number of tons* of coal consumed in heating the excess air out of every 100 tons* of coal burnt in the furnace, we have, remembering that

$$N_2 = 100 - (CO + CO_2 + O_2),$$

and that $S = 0.2375$:

$$Q_A = \frac{0.4437 (C + 3H) \cdot O_2 \cdot (0.2375) \cdot (T_E - T_A) \cdot 100}{100 - (CO + CO_2 + O_2)} = \frac{M \left[1 - 3.8265 \cdot \frac{O_2}{100 - [CO + CO_2 + O_2]} \right]}{100 - [CO + CO_2 + O_2]}$$

which reduces to

$$Q_A = \frac{10.54 \times O_2 \times (C + 3H) \times (T_E - T_A)}{M(100 - [CO + CO_2 + 4.8265 O_2])}$$

CONCLUSIONS. From this formula the following conclusions can be drawn:

(1) The loss of heat due to excess air is directly proportional to the excess of temperature of the exit gases over the temperature of the surrounding air. Hence the advisability of keeping the exit gases at as low a temperature as possible.

(2) The loss of heat is nearly proportional to the quantity of free oxygen present, but increases somewhat more rapidly than the percentage of free oxygen, i.e., if we double the percentage of oxygen, we somewhat more than double the loss of heat.

(To be continued)

Stonework on Enormous English Concrete Building

THE HUGE OLYMPIA exposition building in London is not only one of the largest reinforced concrete structures in the world, but sets an enviable record for speed in construction. Eighty-four engineers were employed in the calculation and design of the steel structure, and 90 erectors worked continuously, two shifts each day.

In the covering of the front of the building 1,570 cu. ft. of reinforced stone were manufactured per week, some weighing as much as five tons each. This is probably a record-sized stone for facing purposes.

In addition to the steel erectors, 300 men were employed continuously on the job and 40,000 sq. ft. of the concrete flooring was laid in seven weeks. Four steam "navies" were used for the excavations, and 34,000 tons of earth removed from the site in 20 weeks.

All this had to be done in order to produce the necessary floor space for the British Industries Fair, providing large spans of open floor space unencumbered by columns. The spans at Olympia are claimed to be the largest in the United Kingdom, columns being placed over 50 ft. apart.

Canadian Cement Production Reaches High Mark in 1929

CANADA REACHED the high total of 12,284,081 bbl. of cement produced during 1929, according to the Bureau of Statistics, Department of Mines. This represents a gain of 1,260,153 bbl. over 1928. Production figures by months in barrels were: January, 385,679; February, 430,710; March, 581,815; April, 796,475; May, 1,233,644; June, 1,579,163; July, 1,669,915; August, 1,697,089; September, 1,447,388; October, 1,423,489; November, 760,083; December, 278,631.

At present the Canadian cement industry comprises 11 plants and is scattered throughout the provinces of Quebec, Ontario, Manitoba, Alberta and British Columbia, those situated in Quebec having an output of approximately 45% of the country's production, while those in Ontario furnish 35%. Fairly extensive stocks carried over from the previous year are given as the reason for a decline in production during the first two months of 1930 from 816,389 bbl. in 1928 to 565,005 bbl. this year.

Exports also showed a decline during the first three months of this year as compared with the same period during 1929. South America takes the bulk of Canadian cement export. During the year ending March 31, 1930, 222,677 bbl. were exported, value, \$256,352.

Supplement to Rock Products, Volume XX



Hercules Cement Corp. plant at Stockertown, Penn.; and

ts, Volume XXXIII, No. 19, September 13,



ment Corp. plant at Stockertown, Penn.; annual capacity, 2,000,000 bbl.

13, 1930



Study of a Group of Crushing Plants in the Central West

Part II—Stripping Operations

By Earl C. Harsh

Associate Editor, Rock Products

AS STATED in the first of this series in the August 2 issue of ROCK PRODUCTS, some thirty crushing plants and quarries were visited and their operations studied in preparing these articles. For obvious reasons it was desirable to omit reference to these operations in any way that would identify them. Instead, the effort is made to compare and discuss the operations in a manner that may prove helpful to quarry and crushing operators generally. We believe such a comparison is particularly helpful at this time when the crushed stone industry is attempting to work out a uniform cost-accounting system.

At those quarries under consideration the overburden varies from an average thickness of 2 ft. at one quarry up to an average of 12 ft. at another, while the depth of quarry face being worked ranges from 17 ft. up to 67 ft. One quarry has a depth of face of 58 ft. and only 3 ft. of overburden, while at the other extreme one quarry has a depth of face of 25 ft. with 12 ft. of overburden. In terms of the depth of the quarry face being worked the overburden varies in thick-



Special 3-way dump truck operating on standard gage track used in a few plants for removing stripping

ness all the way from 5% up to 50%, with an average ratio of overburden to rock of 20% for the whole group.

Because of going deeper with the quarrying operations no stripping is being done at present at about one-fourth of the operations, but at the remainder the overburden is removed with power shovels and transported with cars and locomotives or with trucks, except in one instance where a movable belt conveyor arrangement is used. The general practice has been to pile this material up

on a dump, usually located out of the way at the end of the property, although at several operations it is dumped back into a worked-out part of the quarry—of course whenever possible it is disposed of to the railroads for fills.

At about three-fourths of the quarries where stripping is being done small shovels with 1- to 2-yd. dippers are used for this purpose, while at the others the quarry shovel is moved up on top and used for this work during the winter season or while the plant is not in normal operation. This latter method has the advantage of course of utilizing part of

the equipment regularly used in the quarrying and crushing operation, and of keeping part of the regular crew at work over the winter period. When handled in this way the same cars and locomotives are used as at the bins for the handling of stone to the storage piles.

About half of the smaller shovels used in stripping are steam and the balance electric or gasoline, with an increasing use of small electric crawler type shovels.

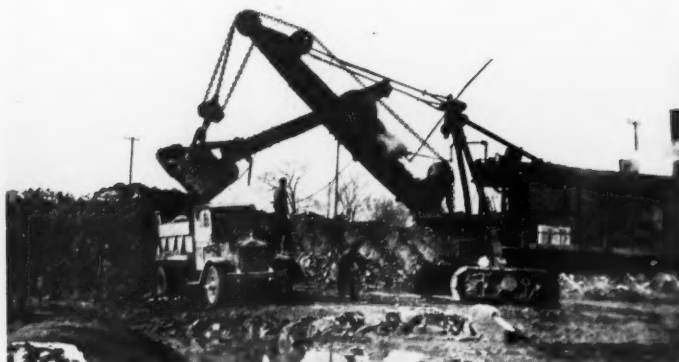
For moving the stripping, cars and locomotives are used at about twice as



Two views of typical stripping operations



Using small shovel and side-dump cars drawn by gasoline locomotives



Removing stripping with large shovel to trucks or side-dump cars

many plants as trucks, standard-gage track generally being used. When more than 30,000 or 40,000 yd. of dirt are involved it is more economical as a rule to use cars and locomotives. The cars used are for the most part Western type, side-dump cars ranging in size from 5-yd. to 15-yd. Two of the larger cars are used together, or five or six of the smaller ones, to make a train, and two locomotives and trains are used when available. In this way anywhere from 500 to 1200 yd. of stripping are moved per day, depending upon whether one or two trains are used, and upon the distance away of the dump and the condition of the track, this operation being carried on with crews of various sizes ranging up to 15 or 20 men.

The proper solution of the stripping problem is of course important as it is often 15% or more of the total cost of getting out crushed stone.

Stripping at Small Operations

A method which has been used satisfac-

torily at several of the smaller operations or where the stripping is light is to excavate it with a small shovel, loading to a special Mack truck car operating on a standard-gage railroad track to the dump.

The Mack truck car has a special 4-yd. three-way dump body which permits dumping on either side or on the end, and is also arranged with a special dual reduction drive with 4 speeds forward and 4 speeds backward, so that it will travel just as fast backward as forward. It has the usual tire wheels for highway operation used in moving from one quarry to another, and also a set of flanged car wheels for operation on standard gage railroad track, the two sets being easily and quickly interchangeable. It is operated backward with its load up to the dump, returning empty in the forward direction to the shovel, and has proven a simple and economical method of handling the stripping at the smaller operations. From 200 to 300 yd. per day may be handled in this way with a total crew of 4 men.

The most interesting and unusual stripping operation, and the only one of its kind

to be found in this group, is where the quarry depth is 25 ft. with an average overburden of 12 ft. or practically 50%. This is considerably more stripping in proportion to the quarry depth than usual, but in this case the method of removal is such as to keep the cost from being excessive. The material is excavated by a 1¾-yd. Model 37 Marion caterpillar type electric shovel, which empties directly into the feed hopper of a long portable belt conveyor unit extending out over the quarry beyond the shovel cut and the quarry railroad track to the worked-out part of the quarry. This device was designed and made by the F. M. Welch Engineering Service, Inc., Greenville, Ohio, and is a special adaptation of what is known as the "Greenville stacker."

This unit consists of a belt conveyor 36 in. wide by 150 ft. long, with skirt boards the entire length, and mounted on a light structural steel frame which is pivoted on the main frame in such a way that it may be tilted as necessary in moving or to compensate for any unevenness of the rock surface. It normally operates on a slope of about 15 deg. The feed end of the conveyor frame rests on the rock and is provided with two transverse rails bent up at the ends, which act as skids or slides to support this end and facilitate moving. Under the feed hopper is a short steel apron conveyor which feeds the material on to the belt conveyor. Both the belt conveyor and its feeder are driven by a 40-hp. induction motor mounted under the feed hopper and feeder, and arranged with push-button control for starting and stopping. The weight of the motor, hopper, and feeder is sufficient to keep this end of the conveyor frame down on the rock, although means are provided for throwing this weight on the main frame when moving, if desired.

The main frame is triangular shaped with a three-point support for greater stability, with two caterpillars on the side next to the quarry face and one caterpillar in the inside, all three being pivoted to compensate



Portable belt conveyor with feed hopper for removing stripping



Unique method of removing stripping with small electric shovel and portable belt conveyor

for inequalities of the rock surface. The caterpillars are connected through driving chains and gearing with a 25-hp., slip-ring motor with drum controller, mounted on the frame, which provides power for moving along the quarry face. Both the conveyor unit and the shovel are supplied with three-phase 60-cycle, 440-volt electric power from a portable power line back of and parallel to the stripping operation. This unit has been used very successfully for two seasons, and handles as high as 1500 yd. per day with a total crew of 4 men. Since it will remove the overburden about three or four times as fast as is required by the shovel operation in the rock, it is only operated three or four months out of the year, but of course in such a way as to keep step with the shovel cuts.

(To be continued)

Heights Where Gravel Is Found Were Once Lower Plain

MANY PERSONS have been mystified by the curious fact that the very tops of many of the highest hills in the southern part of New Jersey are capped with smooth, rounded and water-worn pebbles, such as are commonly found only in valleys or stream beds, while such deposits do not appear lower on the slopes, according to Dr. Henry B. Kummel, geologist and director of the Department of Conservation and Development, State of New Jersey.

"This curious phenomenon is explained," he says. "These hilltops are the remnants of stream beds belonging to an earlier geologic period, and have been formed by the process of erosion.

"This is particularly true of the hills near Clarksburg and Beacon Hill in Monmouth county, and of several summits near Old Half Way along the Ocean and Monmouth county line. These hills rise 150 to 250 ft. above the surrounding lowlands, and are striking topographic features of that region.

"The gravel beds are generally 20 ft. in

thickness and are found on the very summit. They are absent on the slope and on the surrounding lower lands. Pits have been opened on many of the hills, and thousands of cartloads of this gravel have been used to improve the neighboring roads.

"The gravel on the hilltops is a stream deposit, as is indicated by the shape and size of the pebbles. Manifestly no stream could deposit the material on the top of an isolated hill. Yet, since the gravel beds were deposited by streams, we must conclude that these hilltops were once part of the floor of a wide valley across which flowed streams with a velocity sufficient to transport pebbles up to 4 or 5 in. in diameter.

"In other words, what are now the highest points in southern New Jersey were at an earlier geologic period parts of a widespread valley floor, or broad plain, across which flowed numerous streams from the high mountains which then occupied the northern part of the state.

"Rock waste from these highlands was spread by the streams over the bordering lowlands, which only recently had emerged from the sea.

"As the lowland rose higher and higher, the streams gained in velocity and ceased to deposit. Instead they began to wear away the plain and, in the course of hundreds of thousands of years, these hills with their caps of gravel are only remnants of the ancient plain.

"The entire system of hills and valleys of southern New Jersey has been developed by the slow process of erosion since these gravel beds were formed.

"Another proof of the age of these gravel beds is shown by the amount of decay suffered by the individual pebbles. 'Hard as flint' is a common expression; but many of these pebbles, although composed of chert, a variety of flint, are now so soft that they crumble to powder in the fingers.

"And yet when rolled along the bottom of this ancient river they must have been hard, for otherwise they would have been ground to dust."

Uses and Characteristics of Marbles

ACCORDING to a report recently published by the Bureau of Mines, appearance and ability to withstand weathering are of first importance for building and monumental marbles, while appearance is a prime factor for interior decoration. Marble for floors and stairs should be able to resist abrasion, and statuary marble must be pure white and uniformly fine grained. While uniformity of color was once desirable for building work, the present tendency is toward a blending of colors. The important marble belts in this country are in the Appalachian region of the Eastern States and in the Rocky Mountain and Coast Ranges of the West, and about 95% of the marble quarried in 1928 came from Vermont, Tennessee, Missouri, Georgia, Alabama, New York and Massachusetts. At least 80% of the imported marble comes from Italy.

American marbles for exterior building purposes average about \$2 per cu. ft. in rough blocks, while second quality Italian marble sold in New York in 1929 for \$5.50 per cu. ft.

From a practical standpoint in quarrying marble workability is of considerable importance, and the prospective producer should also carefully consider the market, transportation, competitive conditions, etc.

Detailed information on the physical properties of marble, the qualities affecting its workability and use, quarry methods, production, markets, etc., is given in Information Circular 6313, by the United States Bureau of Mines, Department of Commerce, Washington, D. C.

Canadian Investigations of Mineral Resources

THE 1928 annual report of the investigations of mineral resources and the mining industry has been issued by the Mines Branch of the Department of Mines, Ottawa, Canada. This report is known as No. 710, and is divided into four sections as follows:

- I. Preliminary report on the limestones of northern and western Ontario and of the prairie provinces.
- II. Potash salts in the maritime provinces of Canada.
- III. Core drilling bituminous sands in northern Alberta.
- IV. Preliminary report on molding sands in eastern Canada.

Addendum

IN DESCRIBING the plant of the Elmhurst Chicago Stone Co. in the August 30 issue of *Rock Products*, through an oversight no mention was made of the manner in which the loaded cars are switched at the bins. This switching is done by a 25-ton, 6-wheel drive Plymouth gasoline locomotive, which handles as many as four loaded cars at one time.

Gypsum and Gypsum Products Manufacture—Part III

Properties of Plasters—Plasticity, Strength, Water Ratio, Sand-Carrying Capacity, "Normal Consistencies"; and the Effect of Fineness of Grinding

By S. G. McAnally

Chief Chemist, Giant Portland Cement Co., Egypt, Penn.; formerly Chemist for the Pacific Portland Cement Co., Mound House, Nev., and Chemist and Superintendent for the Standard Gypsum Co., Ludwig, Nev.

SINGLE-BOIL STUCCO, or plaster of Paris, is the basic material for the manufacture of fibered and unfibered hardwall plasters, finishing, casting, molding, pottery and wallboard plasters, etc. It is desirable that each finished product possess certain qualities to a high degree, the nature of these qualities depending on the use to which the plaster is to be put; i. e., whether for hardwall, or castings, etc. In general, these qualities are covered by low or high plasticity, sand-carrying capacity, setting time (quick or slow), quick hardening, and strength. Qualities which may be desirable in one plaster will be detrimental to another. Heating and softening are considered defects. They may occur to such a degree in a plaster as to cause it to be rejected as unsuitable for casting plaster; but for slow-setting hardwall plasters, heating and softening are unimportant.

The properties and the quality of plasters (finished products) are controlled and affected by the following: Degree of fineness of raw material, temperature and length of calcination, hotpit storage, regrinding, aging, and by the addition of admixtures (retarders, accelerators, hardeners, fillers, etc.).

If two samples of plaster, one freshly made and the other aged, are mixed with water to the same consistency, the fresh plaster will be sticky and adhesive, and the aged plaster will have the appearance of a wet mixture of very finely ground raw gypsum. The former possesses plasticity to a high degree; the latter is not very plastic. The plasticity of a plaster is not always proportional to the quantity of water it requires to form a wet mixture of predetermined consistency. The quantity of mixing water is affected by the fineness of the raw material; the coarser the grind, the less water required for mixing; but if the degree of calcination is the same, the plasticity is not affected.

Plasticity—Consistency—Water Ratio—Strength

Plasters that do require a high percentage of mixing water are usually very plastic. Plasticity is found to a maximum degree in freshly calcined single-boil plaster. Regrind-

Editor's Note
WATER RATIO, hitherto seldom or never discussed, is just as important to gypsum mortars as water-cement ratio, much advertised, is to portland cement mortars and concrete. The factors affecting water ratio of gypsum mixtures are here discussed for the first time, so far as we can find out, in the technical literature of this country.

ing improves the plasticity. The purer the gypsum, the greater the plasticity of the plaster, yet it is claimed by some that calcium carbonate (limestone) in the gypsum makes the calcined material more plastic. Anhydrite lowers it, as also do impurities that are deliquescent and cause the plaster to age rapidly. The degree of calcination, hotpit storage and aging, affect the plasticity in the same manner as these factors affect the consistency or the quantity of mixing water.

Consistency is a relative term. Normal consistency, as applied to portland cement, is seldom used in testing or in applying plaster. Wetter mixtures are used, and expressed in culinary terms vary from a thick cream to a thin batter, according to the manner in which the plaster is to be used. The property of a plaster denoting its ability for absorbing a certain percentage of water to form a wet mixture of definite consistency cannot be defined as "plasticity." Different plasters may require unequal percentages of mixing water to form mixtures of equal consistency, yet their plasticity, cohesiveness, can be the same; and different plasters that require the same relative amount of water may be vastly different as regards the above quality.

The quantity of water, expressed as a percentage of the plaster, required to produce a wet mixture of definite consistency may conveniently be termed the "water ratio" for that consistency. The use of this term will eliminate the incorrect use of the term "plasticity."

The amount of water required to produce a mixture of definite consistency varies with different plasters, and with the same plaster after different periods of storage or aging. The water for consistency, which will hereafter be referred to as the "water ratio," governs the strength and the sand-carrying capacity of plaster. The higher the water ratio, the greater is the volume of plaster produced. The volume occupied by a mixture of plaster and water bears a close relation to the quantity of water used. The greater the volume, the consistency being equal, the greater will be the sand-carrying capacity.

Table VII shows the volumes produced by unit weight of plasters having different water ratios. The consistency was the same in each test.

These plasters were tested when freshly made; all the samples are "double-boil," which accounts for the low water ratio. It will be noted that the increase in the quantity of water used agrees very closely with the increase in volume. It is evident that the quantity of sand that could be added to each mixture, when wet, and without oversanding, would be greatest in sample A, due to its greater wet bulk; further, the neat covering capacity (yardage) of A would be greater than either B or C, and its covering capacity when sanded would be still greater, due to the larger amount of sand that it will carry.

The water absorbed by the set plasters is

TABLE VII—RELATION OF VOLUME AND WATER RATIO

	Weight of plaster, grams	Water used, c.c.	Volume of set plaster, c.c.	Water absorbed by set plaster, grams	Fineness 200-mesh, not reground
Sample A.....	600	424	637	163	96%
Sample B.....	600	382	595	125	79
Sample C.....	600	343	550	106	65

lowest in Sample C. This figure is, more or less, an index of the porosity of the plasters, and it is to be expected that the least porous will be the strongest. The tensile strength results, which follow, prove this, notwithstanding any retrogression between three and seven days.

TABLE VIII—TENSILE STRENGTHS COMPARED

	Tensile strength, lb. per sq. in.		
	1 day	3 days	7 days
Sample A.....	218	392	388
Sample B.....	210	409	450
Sample C.....	288	553	460

Fibred and unfibred hardwall plasters should possess good sand-carrying capacity; finishing plasters should have high strength; casting and molding plasters should harden quickly and attain high strength at an early period.

Factors Affecting Water Ratio

The factors that affect the water ratio are: Fineness of raw gypsum, temperature and length of calcination, impurities in the plaster, hotpit storage, regrinding and aging.

Tests were made on plasters calcined to different temperatures to determine the effect on the water ratio. All the samples in each test were taken from the same kettle load. Each kettle load differed from the other as to length of calcination to unit temperature, and as to fineness of raw gypsum. The results are tabulated below.

TABLE IX—EFFECTS OF CALCINATION AND FINENESS ON WATER RATIO

TEST I			
Temperature of calcination	Consistency	% mixing water	
260 deg. F.	Thick cream	71	
270 deg. F.	Thick cream	79	
300 deg. F.	Thick cream	82	
340 deg. F.	Thick cream	83½	
350 deg. F.	Thick cream	83	
365 deg. F.	Thick cream	82	
(casting line) 370 deg. F.	Thick cream	79	
½ hr. later 370 deg. F.	Thick cream	76	
1 hr. later 370 deg. F.	Thick cream	72	
380 deg. F.	Thick cream	65	
TEST II			
Temperature of calcination		% mixing water	
290 deg. F.		77	
310 deg. F.		80	
330 deg. F.		80	
345 deg. F.		80	
Consistency—Drier than in Test I			
TEST III			
Temperature of calcination		% mixing water	
373 deg. F.		90	
382 deg. F.		87	
393 deg. F.		82	
400 deg. F.		82	
410 deg. F.		79	
415 deg. F.		75	
Consistency—Very thin cream			

It is generally recognized that quick calcination produces plasters having greater plasticity and higher water ratio than does slow calcination.

Effect of Raw Grinding on Water Ratio

The finer the raw gypsum is ground, the higher the water ratio of the fresh plaster. The results of tests, made to determine the effects of fineness on the water ratio, follow:

TESTS AT MILL A			
Temperature of calcination	% fineness of raw, passing 200-mesh	Consistency	Per cent. mixing water
373 deg. F.	84	Thin cream	97
373 deg. F.	70	Thin cream	90
378 deg. F.	84	Thin cream	94
378 deg. F.	70	Thin cream	86
390 deg. F.	84	Thin cream	85
390 deg. F.	70	Thin cream	79
TESTS AT MILL B			
370 deg. F.	96	Thick cream	68.5
370 deg. F.	84	Thick cream	67.0
370 deg. F.	79	Thick cream	61.5
370 deg. F.	64	Thick cream	53.0

In Mill B tests it will be noted that the water ratio of the first sample (fineness 96% passing 200-mesh) is not much greater than that of the second sample. It has been my experience that a very finely ground raw material (over 96% passing the 100-mesh) does not produce the richest single-boil plaster; i.e., it does not carry the maximum quantity of sand. This may be due to the quicker aging of the very fine plaster, for aging lowers the water ratio and the plasticity.

It has been claimed that regrinding increases the sand carrying capacity of plaster. Regrinding does produce a very bulky powder when the material is loosely packed, but if the reground plaster is packed tightly it occupies much less volume than plaster ground before calcination to the same fineness as the reground plaster. This is shown in the dry volume tests on two plasters calcined to the same temperature, one of which was reground.

DRY VOLUME TESTS

% fineness of raw, passing 200-mesh	% fineness of reground	Dry loose bulk per 100 grams	Pressed bulk per 100 grams
79	—	105 c.c.	73.5 c.c.
65	—	104 c.c.	71.5 c.c.
65	85	134 c.c.	76.5 c.c.

A 600-c.c. container was used for the pressed volume test; a 1400-c.c. container was used for the loose volume test.

The volume of a plaster (dry powder) has a direct ratio to the wet volume only when the plaster is produced from the same raw gypsum, by the same process and not reground. "Plaster produced by the rotary process is from 15 to 20% bulkier than that made by the kettle process, but the wet bulk of the former is not much greater than the wet bulk of the latter." (Quoted from article in *Rock Products*, June or July, 1923.)

The sand carrying capacity of a plaster reground to a certain fineness is lower than that of a plaster having the same fineness but which has not been reground. The following results show this clearly. The same consistency was used in each test.

Fineness of plaster (raw) before calcination, % passing 200-mesh	Reground to % passing 200-mesh	% mixing water	Wet volume per 100 grams of plaster
84.5	—	67.0	—
79.0	—	62.0	99.2 c.c.
65.0	—	53.5	91.8 c.c.
65.0	85	56.0	94.8 c.c.

Regrinding does not lower the sand carrying capacity; indeed, it increases it a little. The increase in fineness between two regrinds on the same plaster does not increase the water ratio, or the sand carrying capacity, in the same proportion as does an equal increase in the fineness of the raw feed.

	% mixing water
Plaster reground from 55% to 78%, 200-mesh	60.0
Plaster reground from 55% to 87%, 200-mesh	64.0

Regrinding produces very smooth wet mixtures, and as it has only a slight effect on the water ratio, it is recommended for casting and similar plasters.

Effect of Hotpit Storage on Water Ratio

If calcined gypsum, single- and double-boil, is held in the hotpit for any length of time the water ratio is lowered, and the longer the plaster remains in the hotpit the lower will be the water ratio and the sand carrying capacity. If the plaster is to be used for making fibred or unfibred hardwall or for products in which bulk or yardage is more important than strength, it should not be left in the hotpit for any length of time and certainly not to exceed one hour. The exception to this is where, due to mechanical or electrical troubles, the calcination of a partially calcined batch cannot be carried to completion before dumping the kettle load. Under these conditions, if the temperature of the material can be brought to 290 deg. F., and the batch is dumped and held in the hotpit for one hour, it will be satisfactory as to setting time, plasticity and sand carrying capacity. The following quotations from my notes describe two occurrences when hotpit storage was used to advantage.

"February 3, 192—. Power went off at 3 p.m.; temperature of kettle load at 285 deg. F.; very hard pulling on kettle (manual labor) due to settling of material; decided to dump at 295 deg. F. Sampled material on top of hotpit as soon as charge was dumped (Sample 1) and re-sampled from top of hotpit after one hour (Sample 2).

Sample	Consistency	% mixing water	Setting time
1	thick cream	79	41 min.
2	thick cream	80	49 min.
From previous dump at 340 deg. F.			
	thick cream	80	48 min.

"February 18, 192—. Power off at 5 p.m. Temperature below 260 deg. F. Had the crew pull on kettle belt; fired with wood; dumped at 285 deg. F.; held material in hotpit one hour. Took average sample while elevating to storage bin. Setting time 43

TABLE X—EFFECT OF HOTPIT STORAGE ON WATER RATIO

Calcining temperature	Fineness of raw material— % passing 200-mesh	Time held in hotpit—hours	Consistency	% mixing water
350 deg. F.	85	0	thick cream	70
350 deg. F.	85	½	thick cream	70
350 deg. F.	85	1	thick cream	69
350 deg. F.	85	1½	thick cream	68
350 deg. F.	85	2	thick cream	67
350 deg. F.	45	½	thick cream	60
350 deg. F.	45	2	thick cream	56
350 deg. F.	45	9	thick cream	46
370 deg. F.				
(start of second boil).....	45	½	thick cream	58
(start of second boil).....	45	2	thick cream	50
370 deg. F.				
(near end of second boil)	85	0	thin cream	92
(near end of second boil)	85	½	thin cream	80
(near end of second boil)	85	2½	thin cream	63
390 deg. F.	(not determined)	0	thin cream	85
390 deg. F.	(not determined)	2	thin cream	76

min.; water ratio O.K." The results show the effect of hotpit storage on water ratio.

The results show that hotpit storage affects coarsely ground material more than it does finely ground material; and that the higher the calcining temperature, the greater is the decrease in the water ratio due to such storage. Finely ground single-boil plaster is the least affected.

(To be continued)

Cleaning Low Grade Bauxite

THE possibilities of cleaning low grade bauxite from the Appalachian field have been investigated by the United States Bureau of Mines and the results are given in Serial No. 2906, which was published recently. The authors are B. W. Gandrud, associate metallurgist, Southern Experiment Station, and F. D. De Vaney, assistant metallurgist, Mississippi Valley Experiment Station. The field includes the deposits of Alabama, Georgia and Tennessee, from which nearly a million tons have been taken, and probably the newly opened Mississippi deposits. Production in this field has fallen off in the past five years as the deposits of commercial grade have been exhausted, but there remains about a million tons of low grade material which could be marketed if a method of concentrating it could be found. At present 90% of the bauxite mined in the United States comes from the Arkansas field.

Thirty-five samples were examined and some of them showed that the valuable mineral, gibbsite, was so interlocked with other minerals that crushing to 100-mesh would not liberate it. Other samples showed that it could be liberated by crushing to 4-mesh or 8-mesh. Float-and-sink fractionation by heavy liquids did not separate some of the impurities so froth flotation was tried. Fairly good results were obtained by this method after the pulp was "conditioned" by being agitated with sodium sulphide. This required at least ten minutes. Oleic acid with kerosene or machine oil was then

added and the pulp was frothed in the ordinary laboratory flotation machine, the gibbsite going off with the froth. The shaft speed of the machine, by which the vigor of the agitation given is regulated, was found to be an important factor of the process.

The results of the tests were such that the authors of the paper believe that the cleaning of some of the high silica bauxites of the Appalachian field is a commercial possibility. It is not thought possible to clean them to a grade that would do for making metallic aluminum, with a silica limit of 5%, but it is believed that they can be cleaned for chemical manufacture, where the silica limit is 15%. Moreover, as the raw material has to be crushed, the concentrate might be salable as pulverized bauxite, which brings a higher price than the lump form, recent quotations being \$7.50 to \$8 for the lump and \$14 for the pulverized.

A considerable part of the cost would be the cost of sodium sulphide which, according to the experimental showing, would be about 18c. per ton of raw rock treated. All attempts to find a substitute for sodium sulphide were failures. The only specimens to which the method worked out was found to be applicable were those which were not too soft and clay-like and those in which the gibbsite was not too closely interlocked with the valueless minerals.

Marble

THE TERM "marble" in its geologic sense is applied to rocks consisting of crystallized grains of the carbonates of calcium or magnesium or both and regarded as metamorphic rock resulting from the recrystallization of limestone, while in its commercial sense it has a much wider application and includes all calcareous rocks capable of taking a polish, as well as serpentine rocks which are attractive in appearance and capable of taking a good polish.

Marbles may be classed in three groups:

The first group, by far the largest, comprising those resulting from the recrystallization of limestones, which are usually white but may also have markings and veins; the second group comprising the onyx marbles which are chemical deposits of calcium carbonate often marked by iron and manganese oxide layers and also often semi-translucent; and the third group including the green marbles, chiefly serpentine, which is a hydrous magnesium silicate with streaks and veins. Practically all marbles and particularly colored marbles contain impurities such as silica, iron and manganese oxides, and alumina, often in combination, which give the veins and markings desirable for decorative uses.

The use of marble is mainly for building and monumental purposes and interior decorating and statuary, about three-fourths of the marble produced in this country being used in building work. Appearance is a prime factor in its value for such uses, although of course ability to withstand weathering and abrasion are important where used outdoors or for floors and stairs. Besides coloring and hardness, other physical properties of value are low porosity, uniform texture and strength.

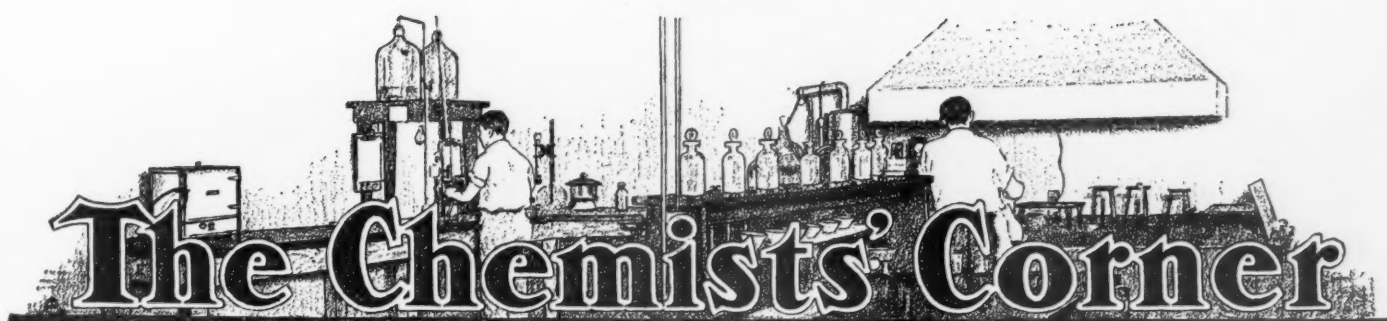
Statuary marble is the most valuable variety and must be pure white and of uniform fine grained texture adapted to carving.

The weight of marbles ranges from 165 to 180 lb. per cu. ft. and it is sold by the cubic foot except in the case of slabs 2 in. and less in thickness which are sold by the square foot. Blocks must be at least 5 or 6 ft. long, 3 ft. or more in width, and 2 ft. or more in thickness.

The waste and broken pieces from marble quarrying and cutting operations are utilized in making terrazzo and stucco, for fluxing and chemical uses, and in lime manufacture.

Much additional information on the composition and physical properties of the different kinds of marble, their uses and the methods used in quarrying them, as well as information on prices and marketing, and statistics showing the production in this country and the importations from abroad during the years 1919 to 1928, inclusive, are given in Information Circular 6313, by Oliver Bowles and D. M. Banks, issued by the Bureau of Mines, Department of Commerce.

The statistics show that in the ten-year period the production in this country has more than doubled to a value of slightly under 16 million dollars. This is on a total production for 1928 of 4,000,000 cu. ft., indicating an average price of just under \$4 per cu. ft. The marble used on building work makes up three-fourths of this, having tripled in the period, while the marble used in monumental work remains about the same. During this same period imports have increased more than two and a half times to a value of 2½ million dollars in 1928. The tariff on marbles is now \$1 per cu. ft.



Effect of Sulphate vs. Sulphide in the Raw Material on the Strength of the Portland Cement

(Reply to article by Alton J. Blank)

By Katsuzo Koyanagi

Chichibu Cement Co., Ltd., Tokyo, Japan

IT IS GENERALLY believed among cement people that sulphate and sulphide in the raw material spoil the quality of cement, but there are not many researches on this subject to be found in the cement literature.

We have carried out in our laboratory during a long time many experiments on the effect of sulphate and sulphide on the strength of cement. The results of these experiments will serve as a reply to the criticism which Alton J. Blank has made in his discussion in *Rock Products*, June 7, 1930, of my experiments on "Iron Oxide vs. Alumina as Fluxing Agents in the Manufacture of Portland Cement," reported in *Rock Products*, May 10, 1930.

All burning tests reported below have been carried out with a laboratory rotary kiln with oil burning.

1. Effect of Sulphate in the Raw Mixture on the Strength of Cement

We have material with high sulphate content, of which analyses are given in Table 1. We made raw meal with various contents of SO_3 by mixing these materials with ordinary cement raw mixture or limestone, and burnt them in the test kiln. All clinkers were burnt very hard. We added then the same amount of gypsum (1.2% as

SO_3) to the clinkers and ground them in a test mill. The cements were tested for strength. Table 2 shows the results of this testing.

We see in Table 1 that the more sulphate is present in the raw mixture, the higher becomes the content of SO_3 in the clinker; and both tensile and compressive strengths of the cements with high content of SO_3 are low. The results of this test show that the sulphate in the raw mixture, though it is not

TABLE 1. ANALYSES OF PORTLAND CEMENT RAW MATERIALS CONTAINING A HIGH SO_3 CONTENT

	1	2	3	4	5
Ignition loss	10.00	7.38	5.17	7.14	5.80
SiO_2	18.22	17.32	17.06	16.56	16.40
Al_2O_3	7.78	6.87	7.92	6.91	7.30
Fe_2O_3	2.25	2.18	2.17	2.34	2.29
CaO	47.09	48.52	43.41	41.31	39.50
MgO	1.68	1.49	1.41	1.41	1.36
SO_3	7.46	9.88	13.22	14.56	15.31
S	0	0	0	0	0

TABLE 3. EFFECT OF CARBON REDUCTION OF SULPHATES TO SULPHIDES IN TEST KILN

	Before heating	After heating at 1000 deg. C.	
		For 1 hour	For 2 hours
SO_3	14.10%	1.39%	0.90%
S	0	4.51% (as SO_3 11.27%)	3.33% (as SO_3 8.30%)
Total SO_3	14.10%	12.66%	9.20%
Loss in total SO_3 by heating	0	1.44%	4.90%

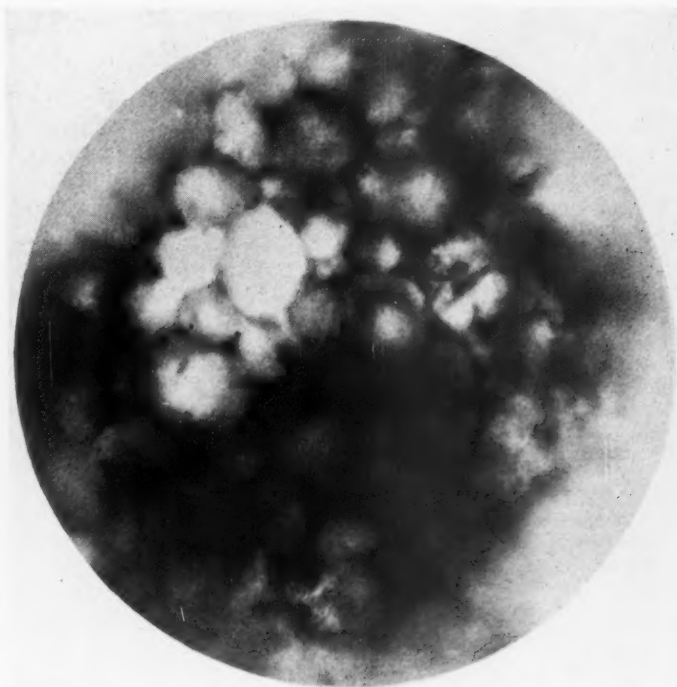


Fig. 1. A hard burned clinker, which contains little SO_3 , consisting mostly of Alit

so harmful so long as its content is low, spoils the strength of the cement when its content becomes high.

We tried to find the origin of this injurious action of sulphate with the help of the microscope. We made slices out of the clinker and observed the minerals in them under microscope.

We found the clinkers out of raw material which contains no sulphate are rich in Alit (Toernebohm's), Fig. 1, while the clinkers, which contain much SO_3 , are very poor in Alit; they consist mostly of Celit and a little Belit (Toernebohm's), Fig. 2.

We studied also the hydration of these clinkers and observed thick short needle crystals as shown in Fig. 3, always in 2 or 3 minutes after mixing with water, in the hydration specimens of the well burnt clinker, which contains little SO_3 .

These crystals are dyed brownish red by the solution of anthrapurpurin in lime water, also dyed blue by the basic solution of patentblue, but are not dyed by the acetic acid solution of methylenblue. They contain lime and alumina but not silicate; must be calcium-hydroaluminat.

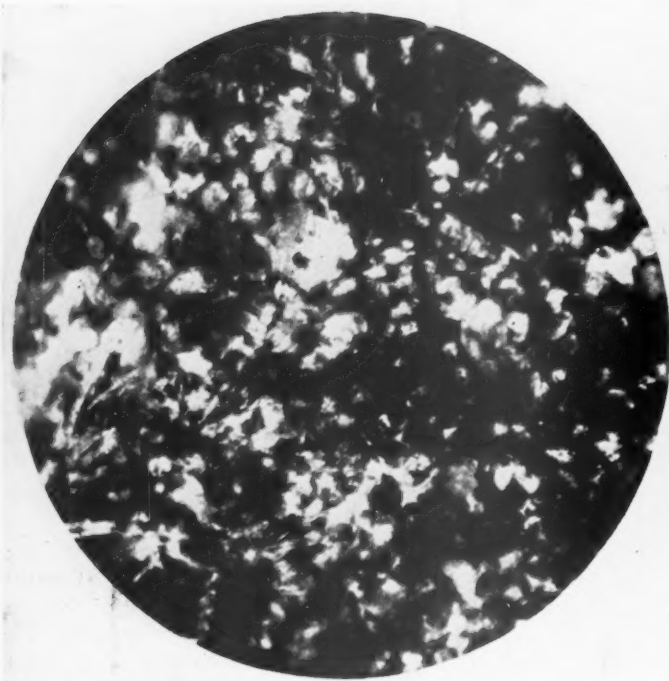


Fig. 2. Hard burned clinker, containing much SO_3 . In the middle one, Alit; other crystals are Celit and Belit

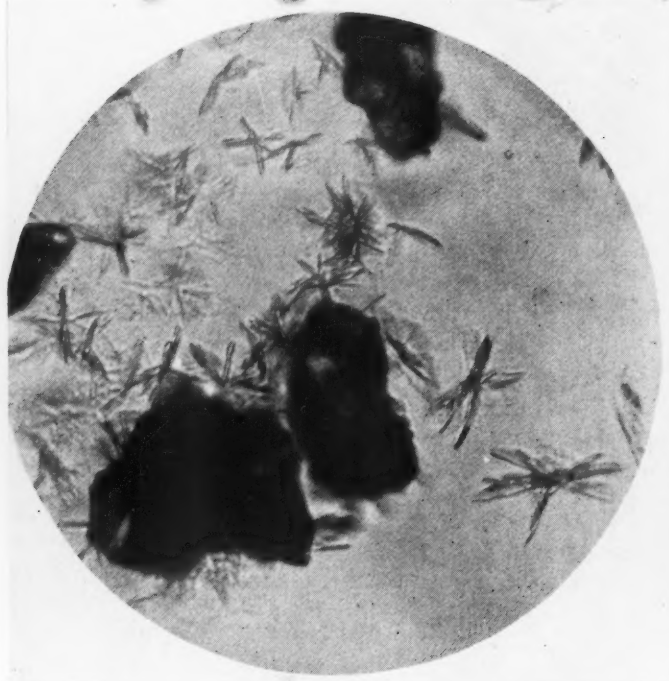


Fig. 3. Hydration of clinkers revealed thick, short needles after mixing with water. Contains little SO_3

The calcium aluminate crystals didn't appear in the specimens of the clinker with high content of SO_3 , though the clinker was very hard burned.

We can imagine from the results of this microscopic investigation that SO_3 combines in the clinker with alumina, forming aluminum sulphate, and thus prevents the formation of Alit, the mineral which has the most important part in the hardening of portland cement.

2. Effect of Sulphide in the Raw Material on the Strength of the Cement

We have seen in the previous chapter that high content of sulphate in the raw mixture spoils the quality of cement very much. We will go now into the effect of the sulphide.

We added certain quantity of pure retort carbon to the raw mixture, which was made by mixing the material in Table 1 and ordinary cement raw meal or limestone, burnt in the test kiln. The sulphate in the raw mixture is reduced in the kiln by the carbon to sulphide before it reaches the sintering zone of the kiln. The fact can be proved with the following small test: We added 5% retort carbon to 1 g. of the material, which contains 14.10% SO_3 , heated in a platinum crucible for one and for two hours on a blast burner. The temperature in the crucible was about 1000 deg. C. Table 3 shows the analyses of the material for sulphate and sulphide before and after heating.

We can see from this test, that by heating the material with carbon the greater part of the sulphate in the material is reduced to sulphide and then volatilized. The chemical reactions which happen in this case can be expressed with the following equations:

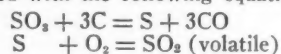


TABLE 2. CHEMICAL AND PHYSICAL TESTS OF CEMENTS MADE FROM RAW MATERIALS OF TABLE 1

Cement No.—	1	2	3	4	5
SO_3 in the raw mixture.....	0	1.51%	1.97%	5.87%	7.71%
Clinker analyses	Ignition loss	0.44	0.31	0.40	0.22
	SiO_2	22.45	22.51	22.51	20.50
	Al_2O_3	6.46	6.57	6.31	5.63
	Fe_2O_3	3.05	3.11	3.04	3.25
	CaO	66.15	66.25	65.80	62.40
	MgO	1.49	1.82	1.89	1.64
	SO_3	0.05	0.08	0.11	3.46
Hydraulic modulus	2.07	2.06	2.07	2.12	2.06
	Silica modulus	2.36	2.33	2.41	2.31
Fineness of cement	4900/cm. ²	4.0	3.5	3.5	4.0
	10000/cm. ²	13.8	12.16	12.24	12.70
Strengths—kg./cm. ²					
	Tensile strength				
7 days	35.1	34.6	34.8	32.1	28.8
28 days	42.0	44.0	42.6	33.6	37.0
Compressive strength					
7 days	504.3	551.0	438.0	355.3	348.6
28 days	672.7	650.6	586.0	425.0	402.0

TABLE 4. TESTS OF CEMENTS CONTAINING SULPHUR AS SULPHIDES

Cement No.—	1	2	3	4	5
SO_3 in raw mix.....	1.97%	2.20%	6.00%	6.83%	5.83%
Carbon added percent. to raw mix.....	2%	3%	3%	5%	10%
Clinker analyses	Ignition loss	0.19	0.02	0.33	0.07
	SiO_2	22.30	23.28	23.06	22.06
	Al_2O_3	6.85	5.06	5.87	6.62
	Fe_2O_3	3.10	2.97	2.94	2.91
	CaO	65.20	67.20	67.10	66.60
	MgO	1.83	0.83	1.05	1.85
	SO_3	0.08	0.02	0.05	0.07
Hydraulic modulus	2.02	2.15	2.11	2.11	2.10
	Silica modulus	2.24	2.90	2.62	2.32
Fineness of cement	4900/cm. ²	3.5	3.5	3.5	3.5
	10000/cm. ²	12.32	12.20	12.4	11.8
Strengths (kg./cm. ²)					
	Tensile strength				
7 days	37.8	35.3	43.0	41.1	39.0
28 days	42.5	45.5	45.3	46.3	44.8
Compressive strength					
7 days	531.3	472.3	545.0	547.3	590.0
28 days	618.6	634.0	632.0	641.3	675.0

Both water and boiling pats of all cements were sound.

In order to make the atmosphere in the kiln completely oxydizing, we blew in air a little in excess of that required for combustion in this case. Table 4 shows the analyses of clinkers and strength of the resulting cements. We can see in this table that only a small quantity of sulphate remains in the clinker and the sulphide has been almost completely driven out and all the cements give very good strengths.

These experiments show that the sulphide in raw mixture is volatilized by burning; doesn't harm the quality of cement, if the atmosphere in the kiln be held completely oxydizing.

Summed up, sulphate in the cement raw mixture, though it is not so harmful when its content is low, spoils the quality of cement when its content becomes high, while the sulphide in the raw mixture is volatilized almost completely by burning, if the atmosphere in the kiln be held oxydizing and doesn't harm the strength of the cement.

Decomposing Aluminous Silicates for Chemical Analysis

EVIDENCE that certain silicates of alumina and allied compounds, especially ceramic materials, can be decomposed for chemical analysis with relatively small amounts of Na_2CO_3 is given in a research paper entitled "A Modified Method for Decomposing Aluminous Silicates for Chemical Analysis," by A. N. Finn and J. F. Klekotka, published in the Bureau of Standards Journal of Research, No. 6, Vol. 4, June, 1930.

After touching briefly on the usual practices for the decomposition of aluminous silicates for chemical analysis and the various literature which has been issued pertaining to the subject, the authors relate the results of initial experiments in which attempts were made to decompose silicates for chemical analysis by heating 0.5-g. samples with equal amounts of Na_2CO_3 in platinum crucibles over gas flames, and from which it became apparent that heating at definite temperatures would probably give better results. Consequently, they used an electric muffle furnace, and temperatures were determined with a thermocouple connected to a portable potentiometer. Conditions were then modified by varying the amount of Na_2CO_3 used, the time of heating and the temperature. It was then determined that the majority of samples tested decomposed readily after heating with Na_2CO_3 at about 875 deg. C. for two hours.

Details of the procedure recommended for applying the sintering method to the decomposition of certain silicates for chemical analysis are given in the paper, and although the work described is based on tests of a relatively few kinds of aluminous silicates, it is the belief of the authors that the method can be applied to other silicates by proper adjustments of the relative amounts of sample and Na_2CO_3 used and the time and temperature of sintering.

Aggregates and the Microscope

DETERMINING THE behavior of various types of natural rocks, when subjected to the action of modern traffic, with the aid of microscopic analysis was the subject of an instructive paper prepared by Dr. Bernard Knight, M.Sc., Ph.D., A.M.I.C.E., F.G.S., chief assistant in one of the English boroughs, and read before the Institute of Quarrying at its recent annual convention.

He outlined the petrological factors affecting wear of stone under traffic as being: mineralogical composition, size of mineral grains, structure of the rock, freshness or otherwise of constituent minerals and the variations in any or all of the factors mentioned. After examining many hundreds of wafer-like sections of stone, Dr. Knight found that the chief differences between various types could be accurately measured and tabulated.

Dr. Knight warned his hearers that it is only by intensive research work that the British quarrying industries can hope to adequately meet foreign competition and the enormous increase in all classes of motor traffic. He cited similar work being done in the United States and Germany as being much farther advanced than in England.

Some Uses for Glycerin

GLYCERIN AND ITS SUBSTITUTES is the title of an article which appeared in *Chemistry and Industry* by W. F. Dorke and E. Lewis. The manufacture of the medicinal and technical glycerins are described as well as the many uses to which the material can be put owing to its unusual chemical properties.

Glycerin is produced mostly from fats and oils, the saponification of which produces glycerin. The crude glycerins are then distilled *in vacuo* with steam producing four grades, among which is dynamite glycerin, a use to which most readers of *Rock Products* are more or less familiar.

Other uses to which glycerin can be put are as constituents of adhesive compounds. By mixing together glycerin and litharge, a product is obtained which, on standing, sets to an exceedingly hard mass. Morawski has found that glycerin and litharge combine, producing a definite chemical compound $\text{C}_8\text{H}_5(\text{HPbO}_3) \cdot \text{H}_2\text{O}$, a compound which can be produced as a crystalline substance by adding glycerin to litharge contained in a caustic potash solution. Glycerin-litharge is the basis of a number of highly resistant cements which can be applied to a variety of uses, and are quick setting, attain great hardness with an exceedingly low contraction on setting, withstand a high degree of heat, are resistant to practically all dilute acids and withstand all organic solvents. The addition of 10% of fuller's earth or sodium silicate to the cement enables the time of setting to be delayed and hence regulated. The properties of the product obtained, and

the time of setting, vary considerably according to the proportions of the ingredients, the most solid cement being produced when the proportion of litharge is high; for example, 90% litharge and 10% glycerin. For practical purposes cements consisting of equal parts of 70% glycerin and litharge have been used. They are plastic over the course of 10 min. and set to a hard mass in 3 hr. The incorporation of other metallic oxides into glycerin-litharge cement mixtures has been found to modify the time of setting and properties of the cements.

Among the applications of glycerin-litharge cements may be enumerated the luting of digesters, cementing glass joints in aquariums, jointing iron pipes and porcelain fittings, producing impressions, making foundation of stamping machines, cementing ornamental stonework where great delicacy of line is required, producing blocks for printing and photographic purposes and for molds for electrotyping and casting metal work in general.

Litharge-glycerin gelatin compounds make excellent cements for leather belts and bands for machinery. Brake linings are produced consisting of an asbestos composition made impervious to water and consolidated by incorporating with glycerin-litharge cement.

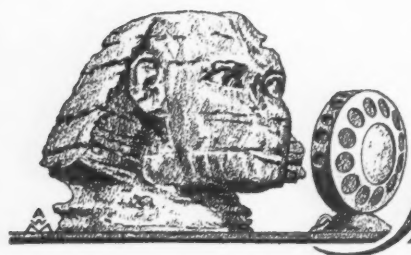
Other Adhesives

Glue can be mixed with various bodies which impart qualities to it little suspected; for example, a solution of glue in water will not attach textile materials to metallic surfaces, but when glycerin is incorporated into the glue solution an adhesive compound is produced which is well fitted to attach many different materials together. The presence of glycerin in glue compounds also serves a secondary purpose in that it sterilizes the product, preventing mold formation. By the addition of a suitable quantity to glue solutions a mixture is obtained which can be used for jointing operations which may be subjected to far more strain than those with glue alone.

Glycerin enters very largely into the composition of office gums and mucilages. A well-known brand of office gum consists of the following ingredients dissolved in water to a suitable consistency:

10% wheat starch,
30% glycerin,
1% carbolic acid,
20% sugar,
39% white glue.

A strong adhesive for paper labels that is well adapted for glazed surfaces consists of a mixture of gum arabic, gelatin, glycerin and camphor. Preparations consisting of mixtures of glycerol and gelatin are used for embedding microscopic specimens for examination. Razor sharpening compositions consist principally of mixtures of equal parts of glue, glycerin and gum in water. Bottle sealing compounds are made consisting of equal parts of gelatin, glycerin and zinc oxide in water.



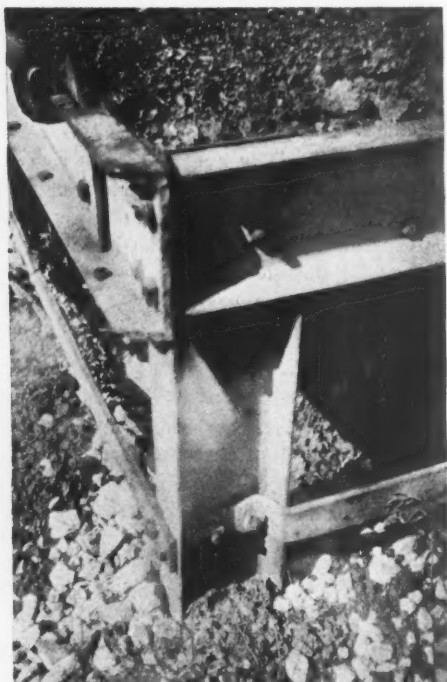
Hints and Helps for Superintendents

A Quarry Forge

A HANDY FORGE and rail heater can be made easily from materials usually at hand around a quarry or sand plant. The forge illustrated here required only short structural iron pieces, such as channels, I-beams and plates, although to add to its convenience and utility a roller has been placed at either end of the forge table as shown in the view. This forge was made where an acetylene cutting and welding outfit was available and the cutting of the structural pieces to fit was easily accomplished by this method.

Four upright, 7-in. I-beams, 2 ft. long are used for the four legs and four 7-in. channels form the four sides of the table. In fitting each corner it is only necessary to cut away one-half of the flange on one edge of the I-beam, leaving the flange on the other edge of the I-beam intact. The channels do not have to be specially cut at all. The corner arrangement is well shown in the illustration. The joints are bolted together, that being the simplest method of making the connection.

Plates cut to shape are bolted across the bottom of this hollow table to complete the fire-box of the forge. This fire-box is approximately 4 ft. by 4 ft., with a depth of 7 in. (the width of the channel used).



Showing corner fitting and roller arrangement on quarry forge

The rollers are placed at each end and are supported by two brackets each. These brackets are angle irons cut to leave only a flat portion to rest against the channel web and a portion at the upper end at right angles to hold the end of the roller. Each bracket is slipped through a slot in the flange of the channel and bolted in an upright position so that it will hold the roller just above the top edge of the channel. The roller revolves in holes in the brackets, and must have a short portion at each end of a smaller diameter which will just fit into the holes in the bracket. These end portions prevent the roller from slipping out.



Strap steel is used for bracing the legs on this quarry forge

The legs of the table can be braced with strap steel as shown if extra strength is required.

For draft for this forge a connection is made to a compressed air hose through a 1½-in. pipe fastened beneath the bottom plates with iron straps bolted to the side channels. The draft comes up through the coke in the fire-box through holes bored through the bottom plates and into the pipe.

Babbitting a Cable in a Socket

By C. H. Wright
Snyder, N. Y.

FROM THE TIME I started out to make a livelihood for myself I have had every experience that any one could wish for in the line of hydraulic, elevator and dipper dredges, and in fact most all kinds of machines that are in any way fitted to be used in operation with steel cables of all sizes, and in all my past experience I have never found a man who babbitted a cable in a socket the same as I do.

Almost every person that I ever saw always babbitted a cable in a socket as I will now explain.

First they mouse or wind the end of the



No. 1. A piece of round iron, cut diagonally, is wound around the cable

cable or burn the ends of the cable together to make it hold while forcing it through the rope socket. If they use wire mousing on the cable, instead of burning or welding the ends of cable together, nine chances out of 10 they will waste perhaps 2 or 3 ft. before the job is complete.

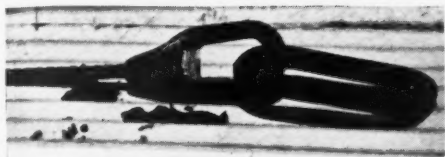
Next when they finally succeed in getting the cable through the socket they wind the cable with wire just where they want to heat and bend it back to form a knob, as we usually call it; then they force it into the rope socket, then drive a short spike or pointed bolts in around the cable; in fact, anything that will have a tendency to tighten cable in the socket. The next operation is to pack clay around small end of socket to make a tight joint, then hang up the socket and fill with babbitt. The chances are it will hold, but there is a much greater chance of its breaking the bent end or pulling out.

When one compares the difference and studies out my theory of fastening a cable in the rope socket by my illustration and explanation they will readily come to the conclusion that it is almost a perfect performance. In all my experience I have never had a cable pull out of a socket.

Going on with the illustration of the cable and rope socket, I might say that this cable is a 1¼-in. diameter true-lay cable, and it is not necessary to either burn or even wind the ends with wire, for it can always be forced into the rope socket; that is, reasonably close fitted. But with any other make of cable, this particular part of the job has to be given a little consideration. I would



No. 2. The ends of the cable are bent back over the ring



No. 3. The cable is pulled into the rope socket and babbitted

suggest heating the end of the cable so that it can be welded together, simply holding the lay of the cable before forcing into the rope socket. After the cable is forced through the rope socket, slide the socket up on the cable, say, 8 ft. or 10 ft., so that the end of the cable can be handled easily without the weight of the socket.

The photograph marked No. 1 shows something wound around the cable $3\frac{1}{2}$ in. from the end. This is a piece of $\frac{1}{2}$ -in. round iron cut diagonally, so when it is bent around the cable after heating it will form almost a perfect ring. When this ring is heated and bent around the cable, after it cools off, it shrinks on the cable, making it very tight. When this is done, heat the cable with a very narrow fire and bend the ends of the cable back over ring as No. 2. Next pull the cable into the rope socket, using a small rope falls by fastening the socket to something stationary, and fasten the other end of the falls to the cable by use of a chain, and the other end of the falls to some piece of machinery that will not be easily moved, then take a good strain on the falls and use the peen end of the hammer to force the cable into the socket a little firmer. Now hang up the cable and socket. Be sure to pack the small end of the socket with clay, being careful that everything is perfectly free of moisture before filling the rope socket with babbitt hotter than will just collar a stick when dipped into the babbitt when heating. When pouring the babbitt pour as fast as possible, as long as it doesn't spatter. Oftentimes I have heated the rope socket to be sure that no moisture is there.

Just a little thought in regard to this link that is welded into rope socket. Usually a link of a chain is welded at the ends. In my past experience I have found that with this link welded at the ends and used for the purpose for which it was intended, the link wears from continual use, and it will not be very long before the weld will begin to show a weakness, or a poor weld will perhaps cause considerable damage, or may prove fatal to some workman. The link will wear as long again, be much stronger and far safer if welded on either side, with the pull on the weld, and with the link bent on the ends, it stands to reason that it is stronger and has better wearing qualities.

Cables 1 in. to $1\frac{1}{2}$ in. diameter use $\frac{1}{2}$ in. round iron for ring.

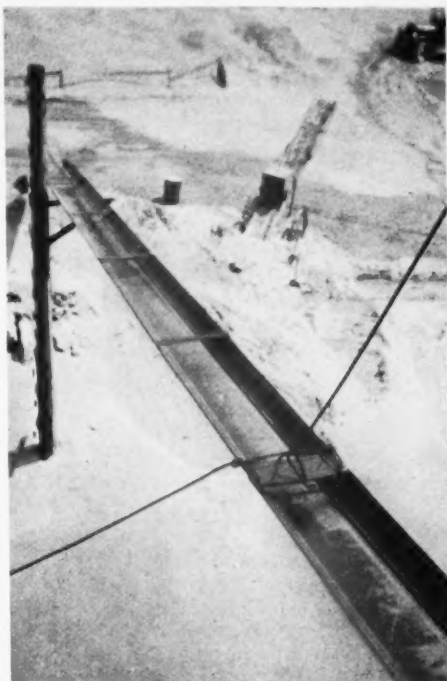
Cables $1\frac{1}{2}$ in. to 2 in. diameter use $\frac{5}{8}$ in. round iron for ring.

Cables 2 in. to $2\frac{1}{2}$ in. diameter use $\frac{3}{4}$ in.

For any cable smaller than 1 in. use $\frac{3}{8}$ in. round iron for ring.

Strengthening Small Chutes to Prevent Buckling

CHUTES and spouts often lack the rigidity necessary to carry them over long unsupported distances and have a tendency to buckle unless supported at rather close intervals. A simple means of adding to the



Looking down on the top of a chute equipped with metal cross straps

strength of such chutes is shown in the accompanying illustration. In this case a chute with slanting sides was to be left unsupported for some 25 or 30 ft. and to prevent buckling pieces of iron—any sort of straps should do—were welded across the top of the chute at regular intervals of about 5 ft. The pieces were strong enough to hold the two sides apart and firmly in position, and thus the sides formed the strengthening feature of the chute, the action being similar to the flanges on channels or I-beams.

Holding Belts Out of the Wind

HIGH WINDS frequently play havoc with the long belts in gravel and stone plants, and one point that is particularly subject to the force of such winds is the belt



Chain fastened across belt protects it from the wind

on top of a stockpiling conveyor. Besides being in the clear sweep of the wind, the belt also rises off the rollers to empty into the traveling hopper which unloads to the various piles below; and at this point the belt can be whipped viciously in the breeze. To prevent this a simple device has been placed on the stockpiling trestle at the plant of Henry Jaeger, near Milwaukee, Wis., so that while the belt is not in use it is held firmly in position. At regular intervals along the trestle upright bolts have been placed at each side of the conveyor belt and a chain is fastened across the belt and slipped down over the bolts at each side. A turn or two of the nuts on the bolts will hold the chain perfectly in position until it is desired to loosen it and start up the belt.

Welding a Crank Shaft

THE ILLUSTRATION shows how a $\frac{5}{2}$ -in. crank shaft which broke through the crank pin was repaired. As the original was only $3\frac{5}{8}$ in. long, only a small knob projected. It was chamfered to a double vee with the cutting blowpipe, and the surface carefully cleaned with cold chisel and wire brush. The shaft was then secured to a heavy leg of the welding table in a vertical position and the end section leveled and blocked in position with $3\frac{5}{8}$ in. between the cranks. When it had been trued up, five $\frac{1}{2}$ -in. stay bars exactly $3\frac{5}{8}$ in. long were cut and tack welded to the throws. This was done to make the welding easier and to keep



Welding a crank shaft through an asbestos shield

the pieces rigid while the shaft was being turned and moved around.

When the stay rods were all welded, a $\frac{1}{2}$ -in. weld was made at the center of the chamfer and then the section to be welded was laid down horizontally and thoroughly preheated. Welding was done through a hole in the asbestos paper covering; the hot metal facilitated the completion of the job and minimized the local effect of the welding flame.

After the shaft was welded—the pin being built up so that it could be subsequently machined to size—it was annealed in order to relieve the last traces of internal strain. Machining was the last step in the repair and soon the wheels of production were turning again after only a few hours' delay.

Lehigh Cement Entertains Local Engineers

THE LEHIGH VALLEY SECTION of the American Institute of Electrical Engineers met recently to discuss final arrangements of the inspection trip for September 27 to the research laboratory of the Lehigh Portland Cement Co. at Ormrod, Penn.

A speaker is to give a talk on the daily operations in the cement mill with motion pictures illustrating these operations. A buffet luncheon will be served at noon, after which the members and their guests will visit the Sands Eddy plant of the Lehigh Portland Cement Co., where there will also be a tour of inspection. Following this there will be either a clambake or chicken and waffle dinner at a place to be decided on later.

Programs and attendance cards will be mailed shortly to all members of the Engineers' Club and A. I. E. E. The programs will describe in detail the educational and social events.

The committee in charge of the arrangements consists of Mark R. Woodward, O. A. Griesmer, D. C. Findley and L. C. Josephs, all of Allentown, and W. I. Schuhmann of Bethlehem.—*Allentown (Penn.) News and Item.*

Revised Specifications for Portland Cement

REVISIONS in the standard specifications and tests for portland cement, involving an increase in tensile strength requirements and the fixing of tolerances for the various pieces of apparatus used in testing cement, have been adopted by the American Society for Testing Materials following a favorable vote by the society's membership in a canvass held this month.

Eleven items in all were included in the revision, of which nine were concerned with tolerances for test apparatus. According to the original report of committee C-1 on cement of the society, lack of definite information on tolerances for test apparatus in the former standard made it practically impossible to determine whether equipment did or did not meet specification requirements.

Revisions in the strength requirements include a change in the average tensile strength at seven days for the three standard mortar briquets from a minimum of 225 lb. per sq. in. to 275 lb. per sq. in., and a change in the average tensile strength requirement at 28 days from a minimum of 325 lb. per sq. in. to 350 lb. per sq. in.

These revisions in strength requirements will bring the minimum values more in line with the general strength level maintained by portland cement plants throughout the country. According to the committee's report, a survey of tests by 116 plants, made during the latter half of 1928, indicated that only a small percentage of the samples tested failed to meet the new standard tensile

strength requirements at the seven day and 28 day periods.

Specifications for high-early-strength portland cement were accepted for publication as tentative by the society's committee E-10 on standards at its February, 1930, meeting. Tentative specifications are the same as the newly revised specifications for portland cement, except that a maximum sulfuric anhydride content of 2.5% instead of 2.0% is permitted, and that tensile strength requirements shall be 275 lb. per sq. in. at one day and 375 lb. per sq. in. at three days. In addition, the purchaser has the option to require a test at 28 days, in which case the average tensile strength obtained shall be higher than the strength at three days.

Copies of the revised specifications for portland cement, and of the tentative specifications for high-early-strength portland cement, may be purchased from C. L. Warwick, secretary-treasurer of the American Society for Testing Materials, 1315 Spruce street, Philadelphia, Penn.

Pennsylvania-Dixie Cement Entertains Traffic Club

MANY DOLLARS have been saved taxpayers by close co-operation on public work between railroads and traffic agencies of manufacturing concerns and the contractors and highway departments, John M. Wilkerson, district sales manager for the Pennsylvania-Dixie Cement Corp., told members of the Chattanooga Traffic and Transportation Club at the monthly meeting.

Mr. Wilkerson, whose headquarters are in Atlanta, declared that the sales departments of large manufacturing concerns are called upon, in this time of speed and accuracy in traffic, to put over railroads' service to customers even more than their own products.

The cement company was in charge of the entire program. J. L. Griffith, traffic manager, had charge of the program. The "Rattlesnake" orchestra from the Richard City plant of the company gave several selections.—*Chattanooga (Tenn.) News.*

Rumors of Mississippi Cement Plant Renewed

AFTER being dormant, apparently, for nearly two years the rumors of a new cement mill to be built "somewhere in Mississippi" are current again. A typical news item in local papers follows:

"A group of cement experts are now making a survey of Neshoba county, with a view of locating a huge cement manufacturing plant in the county.

"These men have been making a thorough investigation, it is reported, and have found favorable conditions and sufficient and proper raw materials. The plant will be of huge capacity, employing more than 2000."

Various reports give the name of B. R. Alford as the cement engineer in charge of investigations.

A. G. C. to Include Residence Contractors

A PLAN for the creation of a residence contractors' section of the Associated General Contractors of America's building division has been recommended by A. E. Horst of Philadelphia, president of the organization, and his cabinet, and is expected to be approved and launched at the fall board meeting, which will be attended by several hundred of the largest general contractors of the country.

The proposed new section of the association is in line with the objective of President Hoover's White House conference on home building and home ownership, to the planning committee of which Mr. Horst recently was appointed by the President.

Studies of current conditions and past trends in the home building field, according to Edward J. Harding, assistant general manager of the contractors' organization, indicate that much constructive work can be done through the establishment of such a section on the same principles that have marked the progress of the Associated General Contractors in handling outstanding problems facing construction in other fields.

Although the Associated General Contractors heretofore has been primarily devoted to the problems of the larger contractors as a group, leaders of the industry now feel that some national trade association should be provided the residence builder to assist him in bettering present trade practices and help him in promoting the construction of more and better homes, Mr. Harding states.

In taking this step toward providing for the affiliation of the residence contractors with the Associated General Contractors special attention will be given to see that methods of promotion, quality of workmanship, appraisal methods and conditions in the second mortgage field are placed on a sound basis, Mr. Harding said. The present depression, he stated, has given emphasis to the fact that the credit system in home building is not as soundly organized as other branches of credit.

Building and loan associations and other financial institutions, small house architects, building supply interests, manufacturers of home building materials, real estate men and other agencies directly involved in the field will be invited to meet on common ground, set up new standards of procedure and initiate soundly conceived active programs for the stimulation of home building, the creation of new confidence in the minds of the public.

The initiative taken by A.G.C. units in Minneapolis, Minn., Portland, Ore., and Spokane, Wash., where home builders' divisions already have been formed, indicates that the contractors of this section of the industry are alive to the possibilities for construction work and that the basis of national affiliation and national effort will meet with their approval, Mr. Harding believes.

Editorial Comment

OUR PLATFORM: Greater Economy of Production; the Best in Machinery and Control Equipment; High Wages; Perfect Co-ordination.
Comprehensive Organization of Industry for Research, Promotion.
Retirement of the State from Competition with Private Business.
Active Participation of Business Men in the Business of Government.
The Promotion of Safety and Welfare of the Industry's Employees.

The announcement on the cover of ROCK PRODUCTS, August 2, that the editors considered the need of industry today was for fundamental information of practical help in making constantly better products at less cost was no mere gesture as only a glance through this present issue will convince the most casual reader. Three articles alone in this issue, by authors whom the whole world recognizes as outstanding authorities, give enough such fundamental, practical information that if only a part is applied will save those who apply it, the subscription price of ROCK PRODUCTS as long as the user lives or remains in business.

For while the present business depression is of course merely temporary, and business in general is already showing signs of recovery, we believe the day has definitely and finally passed when the crude, unscientific, inexact methods of operation of the past will be tolerated in these industries. When an industry fails to avail itself of specific technical knowledge which will aid it in meeting stiffening competition the world over, it no longer deserves "a place in the sun." To continue a waste of fuel and labor, even when fuel and labor are relatively cheap, is little short of absolute incompetency in comparison with the present development of industry in general.

There is a good deal of excuse and reason for the way many operators have operated. All these rock products industries, with the exception of lime manufacture, are scarcely older than the generation of men who now own, control and operate them. Their knowledge was acquired by long and costly experiment and experience. Their knowledge, except in rare instances, has never been recorded in usable published records. But a new generation of operators is coming on, which can not afford, nor can their employers afford to have them, learn the fundamentals of the industry in the same slow, costly way.

It is for their benefit that we have combed the highways and byways of the industry for a *codified record* of knowledge which they must acquire and apply if they are to be successful operators in the future. There are many tools in the industry now to aid them, which the older generation did not have, or has ignored. Those tools are chemical facts, mathematics, indicating and recording instruments. The use of these tools does not call for an extraordinary chemical, engineering or technical education or knowledge; it does call for more application of known facts with greater exercise of educated common sense. We hope and trust it will be ROCK PRODUCTS' mission also to be a constantly more useful tool for such operators.

A curious and outstanding fact in connection with the present business situation is that amusement enterprises are making as much or more money than ever. A philosopher might draft quite an essay on this fact, as a portrayal of American character. We work hard and intensely, enjoy our work, have better incomes, have a much higher standard of living than any other people on earth; but we do not take our work too seriously. Whether general business is good or bad we still have money and time to spend for amusement.

The Public Must Be Amused

It is good to be in an industry which produces a basic commodity that people can not dispense it. Most rock products, cement, lime, gypsum, stone, sand, gravel, etc., are in that class. They may be lowly in the scale of manufactured products, but they are basic. Yet, apparently they are not as profitable as products made for whims and amusement. Food production is surely basic, but at present notoriously unprofitable. The public may not buy cement for dwelling houses, but it is buying considerable for the construction of miniature golf courses.

Since money is to be made in supplying the materials for amusement devices, and some rock products at least can be used for them, why shouldn't this industry do a little something along that line for itself? Various news items say that considerable cement (and, we presume, sand and gravel) is used in the construction of these miniature golf courses. Why leave it to the builder to choose? Why shouldn't the cement manufacturers show where *more cement* could be used to advantage? Why not find a way to use some lime or gypsum mortar?

Why shouldn't sand and gravel producers promote the use of sand both for miniature golf courses, and for children's play yards? A cubic yard of sand per family per year for 10,000,000 families is 10,000,000 cu. yd. and at \$1 a yard (conservative) this is a possible business of \$10,000,000 a year—justifying a promotional expense of at least \$1,000,000! Lime has been sold (although never very seriously promoted) in packages of 10 and 20 lb. for household use. Why not portland cement and plain washed sand? Sand is sold now in small packages (1 or 2 lb.) as "bird gravel" for about as much as the average producer realizes for a ton.

Of course, there are knotty problems of distribution, packing and handling. But the successful producer of today is the one who solves such problems. More and more, as time goes on, ingenuity in merchandising is going to count for as much as ability to produce. Yes, even in basic commodities!

Wall Street View of U. S. Gypsum Co.

THE *Wall Street Journal* (New York City) recently carried the following comment on the United States Gypsum Co., the gypsum industry in general, and the building industry:

"Increase in first half net profit of United States Gypsum Co. as compared with last year reflected results from settlement of the price-cutting competition in the gypsum industry which has caused the company's profits to trend steadily downward over the past several years. Better prices received for products probably accounted for most of the improved profit showing, although low costs made possible by heavy capital expenditures even during the period of declining profits, together with earnings of new plants put into operation in 1929, also contributed.

"The first half increase this year was the more noteworthy in that it came during a period of slack building operations. While a further decline is forecast, report to stockholders says reasonably satisfactory earnings seem probable for the remainder of the year.

"Following table shows net profit for the first half of 1930 and by halves for the previous four years:

	First half	Second half	Year
1930.....	\$2,891,750		
1929.....	2,329,243	\$2,773,061	\$5,102,304
1928.....	3,334,487	2,697,148	6,031,635
1927.....	3,892,301	3,636,206	7,528,507
1926.....	4,130,829	4,244,918	8,375,747

"During the post-war period of building activity net profit rose to \$8,414,116 in 1925 from slightly more than \$1,000,000 in 1919. In subsequent years price-cutting in the industry exerted more adverse influence on earnings than building conditions. With this condition corrected, Gypsum's profits should recover much of the ground lost during the past few years as soon as building turns for the better.

"Even while earnings were declining Gypsum continued its expansion program, fully maintained its working capital position, and continued to build up its net worth. Following table shows working capital, fixed assets, common stock and surplus as of June 30, end of 1929 and the four previous years:

"Balance sheet as of June 30, this year,

Period	Working capital	Fixed assets	Common stock	Surplus
June 30, 1930.....	\$14,929,196	\$58,359,301	\$23,409,440	\$33,075,805
1929.....	12,930,507	56,632,037	22,985,800	30,684,764
1928.....	13,622,328	46,022,197	*15,208,720	27,193,273
1927.....	13,148,008	39,969,762	13,823,960	24,233,219
1926.....	12,861,150	34,371,206	13,757,500	18,804,981
1925.....	13,161,477	28,247,659	10,138,300	16,689,971

*Not including \$7,602,100 common stock subscribed.

shows an exceptionally strong current position, with current assets over ten times current liabilities and cash and government securities together amounting to almost \$7,000,000, against current liabilities of \$1,621,617.

"In five and one-half years ended June 30, last, Gypsum's investment in plant and equipment, before deduction of reserves, more than doubled. These heavy capital expenditures during a period of declining earnings have served to entrench the company still

more solidly in its field. With its mines or quarries in the principal natural gypsum producing areas, and plants strategically located with reference to the principal consuming areas, Gypsum is able to manufacture and distribute its products efficiently and economically.

"Company's capital structure is simple, consisting on June 30 of \$7,841,700 7% preferred stock, \$23,409,440 common stock. Surplus is \$33,075,805. Only items ahead of capital stock on that date were \$1,621,617 current liabilities and \$11,807,327 reserves.

"Because of stock dividends and rights offerings, number of common shares outstanding has more than doubled since 1925 and now stands at 1,170,472 shares of \$20 par, on which first half net profits equaled \$2.24 a share, or considerably more than the full year's requirements of \$1.60 a share.

"In line with its conservative accounting methods, under which its large gypsum deposits are said to be carried on the books at a purely nominal figure, Gypsum has pursued the conservative dividend policy of maintaining a relatively low regular cash dividend rate, supplemented by extra cash dividends, stock dividends, or offerings of rights to buy additional stock below the market price.

"As the number of shares increased and earnings fell off, the regular cash dividend rate was maintained, but the extras in cash or stock were reduced and finally eliminated. No extra was paid in 1929 and none has been paid this year to date. This policy has enabled Gypsum not only to maintain but to strengthen its balance sheet position and thus to place itself in condition to consider more generous treatment of stockholders as soon as its earnings trend again goes up."

Recent Dividends Announced

Canada Cement pfd. (qu.).....	\$1.62½	Sept. 30
Consumers Co. prior pfd. (qu.)	1½%	Oct. 1
Pennsylvania Glass Sand pfd. (qu.)	1¾%	Oct. 1
Republic Portland Cement pfd. (qu.)	1.75	Sept. 1
Warner Co. com. (qu.).....	0.50	Oct. 15
Warner Co. com. extra.....	0.25	Oct. 15
Warner Co. 1st pfd. (qu.).....	1.75	Oct. 1
Warner Co. 2nd pfd. (qu.)..	1.75	Oct. 1

Additional U. S. Gypsum Co. Stock Listed

THE CHICAGO STOCK EXCHANGE has listed 29,670 additional common shares of the United States Gypsum Co., issued in connection with the acquisition of Albert Manufacturing Co., the Northwestern Expanded Metal Co., the Farnam Cheshire Lime Sales Co. and other smaller companies.

Consolidated Rock Products Co.'s Seven Months' Earnings

THE CONSOLIDATED ROCK PRODUCTS CO., Los Angeles, Calif., and subsidiaries, for the seven months ended July 31, last, showed net operating profits of \$183,282.38, according to a statement issued August 28 by Ford J. Twaits, president, together with a letter to stockholders explaining the recent action of the directors in omitting the quarterly dividend of 43¾ cents on the cumulative preferred stock due September 1.

Miscellaneous income for the period was \$23,432.06 and miscellaneous expense was \$33,069.91, leaving profits of \$173,644.63 before bond interest, depreciation, depletion and amortization, which charges aggregated \$728,235.66 and resulted in a net loss for the period of \$554,591.13.

Net sales for the period totaled \$2,322,884.01, from which were deducted production costs covering plant and bunker expense, transportation and materials totaling \$1,911,117.85, selling expense of \$83,690.96, and general and administrative expense of \$144,792.82, leaving net operating profits of \$183,282.38.

The decision to omit the preferred dividend is in conformity with the program of conservatism instituted by the company's management because of the general business depression which resulted in a reduced demand for building materials, Mr. Twaits stated in his letter, which read in part:

"While your company has had to operate during its first 16 months under unusually difficult conditions, particularly since the general business depression of last fall, it has paid out \$1,291,305 on capitalized expenditures. These have consisted of a liquidation of maturing obligations, mortgages, purchase contracts, etc., taken over by this corporation from predecessor companies, investments in subsidiaries, plant and truck equipment purchased, and reduction of funded debt.

"During the same period \$643,125 has been disbursed in the form of dividends to the preferred stockholders. This makes a total of nearly \$2,000,000 cash outlay by your corporation without resorting to any borrowing. Similar outlays subsequent to the date of this statement will amount to a very small figure compared to the above.

"These demands on our cash and the operating losses experienced the last year justify the management's deferring of dividend payments during the period of readjustment.

"The present management has, during its short tenure of office, given close attention to every economy possible and has reduced its production costs and the sales and administrative expenses each month. With the slowly but steadily increasing volume of business being booked, coupled with the improvement of prices which has followed, it is hoped that it will not be long before the

earnings will justify the resumption of dividend payments."

EARNINGS	
(Seven months, to July 31, 1930)	
Net sales	\$2,322,284
Operating expenses	2,138,972
Operating profit	183,312
Bond interest, depreciation, depletion and amortization	728,266
Miscellaneous expenses (net)	9,637
Net loss	554,591
Preferred dividends	262,500

Deficit\$ 817,091

BALANCE SHEET AS OF JULY 31, 1930

ASSETS	
Total property after depreciation	\$13,489,718
Investments in and advances in affiliated companies	119,212
Current assets:	
Cash	182,549
Notes receivable	58,006
Accounts receivable, less reserves	308,014
Cash surrender value life insurance	3,100
Inventory—Rock sand and materials	84,034
Inventory—Material and supplies	55,679
Securities owned	84,105
Sinking fund for bond redemption	61,261
Deferred charges	413,567

Total\$14,859,245

LIABILITIES	
Preferred stock	\$ 7,500,000
Common stock	786,000
Union Rock Co. first mortgage gold bonds	2,339,500
Consumer Rock and Gravel Co. first mortgage bonds	1,454,000
Purchase money obligations, maturing subsequent to January 1, 1931	161,055
Current liabilities:	
Notes payable	15,000
Purchase money obligations due in 1930	106,896
Accounts and wages payable	144,636
Accrued interest	73,017
Accrued taxes, insurance, etc.	61,249
Federal income tax for 1929	11,725
Reserve for collision insurance	10,268
Surplus	2,195,899

Total\$14,859,245

Current assets\$ 691,382

Current liabilities412,523

Working capital\$ 278,859

Offer for Whiterock Quarries Stock

AT A MEETING of the creditors of the former Centre County Banking Co., Bellefonte, Penn., August 28, according to Lee Francis Lybarger, referee in bankruptcy, consideration was given to the petition of Trustee Ivan Walker, to sell at private sale to Ray Noll of Bellefonte, 158 shares of common stock of Whiterock Quarries, the stock being a part of the assets of the defunct bank to be liquidated.

Mr. Noll has offered \$80 per share, an increase of \$10 over the appraised valuation of the stock.

Erratum

WE ARE informed by the Medusa Portland Cement Co., Cleveland, Ohio, that the balance sheet as of March 1, 1930, of their subsidiary, Newaygo Portland Cement Co., as published in the June 21 issue of Rock Products, p. 93, is entirely inaccurate.

The report was taken from an authentic financial sheet which apparently slipped up in this instance, publishing the figures for some other company under the caption of the Newaygo Portland Cement Co. Rock Products regrets publishing this misinformation, received from an apparently authentic source.

Pacific Coast Cement Prices Advance

UPWARD REVISION of cement prices that became effective in southern California a month ago, reflects an attempt to correct a price war situation that had existed in this territory for several months. While this change will not be shown immediately in company earnings in some instances because of the existence of long-term contracts made at lower prices, the increase should materially benefit profits from future orders.

Cement is selling currently in this territory around \$1.72 a barrel, compared with a price range as low in some instances as \$1.04 a barrel that prevailed before the advance. Previous to the recent increase in prices, cement is reported to have been distributed at various times at prices below the cost of production.

Practically all of the cement produced in this territory is locally consumed, and new prices for southern California will not have any material effect on markets in the northern part of the state.

Both production and shipments of cement for the first four months of this year in California indicate considerable declines from comparative figures in 1929. The following figures of the Department of Commerce (in barrels) reflect this situation:

	—Production—		—Shipments—	
	1930	1929	1930	1929
January	718,000	1,034,000	640,000	1,033,000
February	755,000	1,034,000	793,000	984,000
March	873,000	1,170,000	816,000	1,148,000
April	838,000	1,085,000	921,000	1,058,000

—Pacific Coast Edition of the *Wall Street News*.

Pennsylvania City Boosters Would Revive Glass Sand Operation

TOM J. WHITE, chairman of the industrial committee of the Sharon, Penn., Chamber of Commerce, Secretary William E. Matthews and a representative of *The Herald* motored to the Hartford ledges, west of Hartford, Ohio, recently to secure samples of the silica sand deposits there to be forwarded to the Brockway Sand Co. of Buffalo, N. Y., operating a glass bottle factory at Brockway, Penn., which may be moved to Sharon. The samples were sent out recently.

The buildings of the Hartford Sand Co. plant, which operated for several years, were found to be beyond repair and the possibility that the Brockway company would attempt to put the plant in operation appears negligible. The plant was abandoned about 15 years ago and since that time several of the buildings have been torn down or fallen into a state beyond repair. The railroad siding connecting the plant with the New York Central tracks has been removed and a large sum would be necessary to put the plant in operation again. It was still considered possible, however, that the sand could be taken from the ledges and hauled by truck

to Sharon, where it could be prepared for the manufacture of glass at the bottle factory.

The outlook for securing the plant was brightened when Chamber of Commerce officials were notified that a 20-acre deposit of silica sand, said to be 99% pure, exists on the Blaney farm, just north of the Deneen farm, Sharon-Greenville road. This deposit is only four miles from Sharon. Samples were secured and sent to the Brockway company officials for analysis.

The final decision to locate the plant here depends on the availability of silica sand and it is hoped that the deposit on the Blaney farm will prove satisfactory.

Two improved sites for the bottle factory, the property of the American Steel Foundries, Clark street, and the Sharon Pressed Steel plant at Wheatland, now owned by Joseph Greenspon's Sons Co. of St. Louis, are said to be available.—*Sharon (Penn.) Herald*.

Southern Ohio Cement Industry Picking Up

THE PERIOD of industrial depression in Ironton, Ohio, is seemingly at an end. Concrete evidence that better times are at hand came August 30 with announcement that the plant of the Alpha Portland Cement Co. would resume in all departments on the following Monday morning.

Superintendent Brownstead of the cement company announced that work would be resumed with all departments going in full. This includes the underground workers in the mine shafts and those engaged in the mill. Resumption of operation recently was hindered because of the scarcity of water, but wells of the company are now filled and there will be no further trouble from this source.

Several hundred men go back to work as the mill resumes after a period of idleness extending through July and August.—*Ironton (Ohio) Tribune*.

Ohio County Buys Stone at Standard Price of One Dollar

PROVISION for improving approximately 108 miles of Allen county (Ohio) unpaved roads was made recently when county commissioners authorized the purchase of 2100 tons of stone for each of 12 townships.

Under provisions made by the commissioners, each of the three trustees of the 12 township boards will be allotted 700 tons to be distributed as the trustee orders. County Surveyor John Breese estimated that, by spreading the stone thin, 700 tons will be sufficient to improve three miles of road.

The volume of stone involved in the improvement program is 25,200 tons, which at the standard price of \$1 a ton aggregates an expenditure of \$25,200.—*Lima (Ohio) Star*.

F. H. Gades Makes New Gravel Company Affiliation

F. H. GADES, who has been identified with Topeka, Kan., sand companies for many years, recently announced his resignation as vice-president and sales manager of the Consumers Sand Co. He has purchased the Browning Sand Co. plant at Lawrence, Kan., and already has started the operation of the plant under the firm name of the Lawrence Sand and Gravel Co.

Mr. Gades was connected with the Consumers Sand Co. since its organization in 1926. Prior to that he operated the Wear Sand Co. of Topeka, the firm later merging with the Consumers Sand Co. Mr. Gades also formerly was connected with Crane and Co. of Topeka. He was born and reared in Topeka. He will move his residence to Lawrence this fall.—*Topeka (Kan.) Capital*.

Gifford-Hill and Co.'s New Gravel Plant in Louisiana

"BELLE CHENEY" is the name that has been given to the new Gifford-Hill and Co. gravel plant near the springs known by that name and one mile north of Turkey Creek, La. Belle Cheney is two and one-half miles from the Rock Island railroad and has a ballasted track running from the plant to the main line. (The home office of Gifford-Hill and Co. is Dallas, Tex. The company operates five other plants in Texas and Louisiana.)

Gifford-Hill and Co. has leased 700 acres of land for its new plant, 200 of which have been tested out and found to have a layer of white gravel and sand 80 ft. in depth covering the tested area.

The up-to-date equipment which has recently been installed is characteristic of the company, whose motto is "Efficiency." The steel boat is 36 by 60 ft. by 4 ft. 6 in. and is fitted with 10-in. gravel pump, 240-hp. Fairbanks-Morse Deisel engine, cutter, hoist, air compressor, etc., using 60 ft. of pipe on the suction.

The boat pumps direct to a screening plant, which consists of scrubber and three sets of screens, operated by 50-hp. Deisel engine. The screened gravel runs from 2- to ¼-in. and is clean and well graded. The gravel falls direct from screens to cars, thus eliminating the necessity of storage bins and making the loading process ideal. The plant also furnishes the electricity for the lighting system which is in use at Belle Cheney.

The grading of the sand is fixed through settling tanks, the grade, it is said, being superior for concrete work.

A 60-ton locomotive handles the present shipping capacity, which is 20 cars daily, and most of the material now being moved is for paving jobs.

Aside from the gravel plant proper, there are the machine shops, the commissary, the dining hall, superintendent's cottage, several cottages for employees, quarters containing

rooms for single men, a water tank, and oil storage tanks. In short, Belle Cheney is fast taking on the proportions of a small town, and the future of the plant here is most promising. The remaining 500 acres of leased land is thought to be rich in material and the mining operations will expand as the demand necessitates, until the entire tract has been gone over. Belle Cheney is one of Gifford-Hill and Co.'s prize plants and its development is a big asset to the community in that it brings new people in; it also offers employment to many who, on account of crop failures, are looking to public works to tide them over the winter.—*Alexandria (La.) Town Talk*.

Wisconsin Locality Insists on Crushed Stone for Bituminous Road

RECENTLY the contract between the Green Bay Materials Co., a Sturgeon Bay (Wis.) concern, and the county highway committee was signed for 20,200 cu. yd. of crushed stone to be delivered on Highway 78 north for 7½ miles starting at Institute. The material is to be furnished by the Sturgeon Bay company from their quarries on the bay shore north of this city. The price was \$28,095.

The work of spreading the material on the road, which is to form the base for the bituminous road, will be done by the county. The stone company is prepared to start filling the order at any time and can deliver 500 cu. yd. per day. The stone will be crushed at the quarry and delivered on the road by trucks.

The selection of crushed stone on this section of the construction work on Highway 78 was brought about by a vigorous protest on the part of citizens over using gravel from the county pit at Clark's lake. Their contention was that crushed stone would make a better base for the bituminous road.—*Sturgeon Bay (Wis.) Advertiser*.

Memphis (Tenn.) Gravel Plant Sold

PURCHASE of the old plant of the Raleigh Sand and Gravel Co. on Cedar Grove road, Memphis, Tenn., was announced recently by J. H. Powell, president of the Powell Lime and Cement Co., 2814 Broad street, Memphis. The plant has trackage on the L. and N. railroad.

The Raleigh concern maintained an office at the Powell company's plant, and the purchase now gives full control to the latter. R. L. Pemberton is vice-president of the Powell company, which built a new plant two years ago, with trackage on both the L. and N. and the Illinois Central.

Mr. Powell said the Raleigh plant will be remodeled within the next 60 days before production of sand and gravel is resumed.—*Memphis (Tenn.) Commercial Appeal*.

Central Illinois Gravel Plants Active

SPRING VALLEY'S (Illinois) principal industry is one which attracts perhaps very little attention and is that conducted by the Western Sand and Gravel Co., which employs over 30 men in producing daily during the summer months 3000 tons of road gravel.

The local company which has at its head J. C. Sitterly with his son, Glenn, in charge of the business offices and another son, Lyle, in charge of the two plants at Spring Valley and Granville, produces gravel as long as weather conditions permit. The plants open as early in March as weather conditions permit and close during the period from December 1 to 15, depending entirely upon weather conditions.

At the company's pit here, located just east of the city and east of the Burlington railroad, which road is used for the shipping of the gravel in carload lots, the road material is produced 24 hours a day during the five months of June, July, August, September and October. Two 12-hour shifts are employed during this period. There are nine men on each shift.

The most modern type of machinery is used in dragging the gravel from the pit—the northeast corner of the pit is being used now—and conveying it to the plant where the larger rocks are crushed in a powerful crusher and where the gravel is then loaded into cars for shipment throughout this sector of the state. Although the plant here is equipped with a washer, the washer is no longer used since the plant turns out only road gravel which, unlike gravel to be used for building purposes, need not be washed.

The daily production here is about 40 cars of 50 tons each, a total production of 2000 tons.

At Granville, or the Colby plant, which property was annexed by the Western Sand and Gravel Co. about May 1 of this year, the plant operates 16 hours a day with two shifts of eight hours each and with eight men on each shift. This plant also turns out road gravel, making its shipments on the New York Central and Chicago, Milwaukee and St. Paul railroads. The capacity of the Granville plant is about one-half that of the Spring Valley plant, turning out about 20 cars or 1000 tons of road material daily.—*LaSalle (Ill.) Post*.

New Officers of Texas Sand and Gravel Association

THE FOLLOWING OFFICERS were recently elected by the Texas Sand and Gravel Producers' Association: President, W. E. Sampson, Texas Construction Materials Co., Houston; vice-president, J. Rutledge Hill, Gifford-Hill and Co., Dallas; secretary-treasurer, W. A. Wansley, W. D. Haden Co., Houston; directors: Roy Eastland, T. M. Norsworthy, Tom Popplewell and R. J. Windrow.

WESTERN TRUNK LINE DOCKET
6541-B. Mine slag, carloads (See Note 3), but not less than 40,000 lb. will apply, from Mystic, Ia., to stations in Missouri. Present rates, Class E; proposed, to representative points, Gault 88c, Chillicothe 110c, Excelsior Springs 140c and Kansas City, Mo., 160c per ton.

JOINT CONFERENCE DOCKET

Docket S. F. A. No. 696 (former S. F. A. D. A. No. 672) (Submittal No. 49984) (corrected)—Revision of rates on silica (silex) and tripoli, carloads, between points in southern territory and between points in southern territory, on the one hand, and points in I. F. A., C. F. A. (including Buffalo-Pittsburgh territory), Eastern Trunk Line and N. E. F. A. territories, on the other.

Carriers propose to cancel all existing commodity rates on silica (silex) and tripoli between points in southern territory and between points in southern territory, on the one hand, and points in Illinois Freight Association, Central Freight Association (including Buffalo-Pittsburgh territory), Eastern Trunk Line and New England Freight Association territories, on the other, and to establish rates on the following basis:

Silica (silex), flint, tripoli; sand, silica; powdered or pulverized (see note), in packages or in bulk, carloads, minimum weight 40,000 lb.—17% of first class.

Note—Silica (silex); flint, tripoli; or silica sand, powdered or pulverized to such fineness that 90% or more will pass through a mesh of 100 strands to the inch.

Silica (silex); tripoli; crude, carload, minimum weight 60,000 lb.—15% of first class.

Rates from points west of the Mississippi river, including Seneca, Carthage, Neosho, Racine, Crystal City and Pacific, Mo., to be increased to be no lower than the intermediate Mississippi river crossing.

I. C. C. Decision

19943. Lime Scale Revised. The commission in a report written by Commissioner Eastman, on further hearing, in No. 19943 (Sub. No. 1), North American Cement Corp. vs. A. & R. et al., opinion No. 15692, 163 I. C. C. 701-15, has revised the former report, 153 I. C. C. 431, as to rates on lime and ground limestone, from Martinsburg and Berkeley, W. Va., to destinations in Virginia. The former report was made by division 4. In that former report the division found the rates unreasonable and unduly prejudicial and preferential in their relation to the rates on these commodities, applicable intrastate within Virginia, which were the result of orders of the Virginia commission. The so-called southern lime scales, found justified by division 1 in Lime between Southern Points, 129 I. C. C. 635, were prescribed for application from the West Virginia points and also within Virginia. For limestone the scale established by division 3 on asphaltic limestone in Colbert Limerock Asphalt Co. vs. A. C. R. R. Co., 129 I. C. C. 177, was prescribed.

According to Mr. Eastman, the evidence at the further hearing related chiefly to two questions: Is the present relation between the interstate and intrastate rates on ground limestone unduly prejudicial and preferential as alleged by the complainant? And, what level of rates should be prescribed to remove the prejudice and preference as may be found to exist? Mr. Eastman said that upon consideration of the additional evidence the commission had concluded that the scale originally prescribed by division 4 was somewhat too high; and that to harmonize with the southern lime scales, joint-line arbitraries

should be limited to rates for 100 miles and less.

The commission found that the rates on ground limestone from Martinsburg and Berkeley to points in Virginia were and for the future would be unjust and unreasonable to the extent they exceeded or might exceed rates made by the use of a scale carried in an appendix not here reproduced. It further found that the complainant was unduly prejudiced and that its competitors at Ripplemead, Riverton, Strasburg, Staunton, Eagle Mountain, Indian Rock, Strasburg Junction, Barber, Rocky Point, Austinville, Alco, Marion and Pontmour were unduly preferred by the present relation between the rates on ground limestone from Martinsburg and Berkeley, on the one hand, to New Market, Va., and all points in Virginia north thereof on the Harrisonburg branch of the Southern, the Shenandoah district of the B. & O., the Cumberland Valley division of the Pennsylvania, and the Washington and Old Dominion; to Shenandoah, Va., and all points north thereof on the Shenandoah division of the N. & W.; Rapidan, Va., and all points north thereof on the Washington division of the Southern; and to all points on defendants' lines in Virginia east of and including Beaver Dam, Lee, Burkeville, Kenbridge, and La Crosse, to the extent that the rates from the Virginia producing points before named to such destinations were less than those which would result from the application of the scale hereinbefore mentioned. The commission found that that scale would be reasonable for intrastate application within Virginia to the extent necessary to remove the undue prejudice and preference herein found.

The commission further found that the rates on lime from Martinsburg and Berkeley to points in Virginia were and for the future would be unreasonable to the extent that they exceeded or may exceed the rates on lime set forth in an appendix affirming the former findings of division 4. It further found that the present rates on lime from Martinsburg and Berkeley to points in Virginia and their relation to rates from Ripplemead, Strasburg, Strasburg Junction, Riverton, Staunton, Eagle Mountain, Indian Rock, Barber, Rocky Point, Austinville, Alco, Marion, and Pontmour to the same destinations were unduly prejudicial to the complainant and unduly preferential of its competitors at the Virginia producing points before named, and that the present intrastate rates on lime in Virginia caused unjust discrimination against interstate commerce.

The lime scale is based on minima of 30,000 lb. and 50,000 lb. The scale based on a 30,000-lb. minimum begins with a rate of 70 cents a ton for a 5-mile single-line haul and 80 cents for a joint-line haul. The 10 cents a ton additional for a joint-

line haul continues up to a distance of 70 miles, at which point the single-line rate is 210 cents and the joint line rate 220 cents. Beyond 70 miles there is an addition of 10 cents a ton for each 20-mile block up to 280 miles, at which distance the rate is 330 cents. The scale continues beyond that point with the addition of 10 cents for each 40-mile block up to 520 miles, at which the rate is 390 cents.

The 50,000-lb. scale begins with a rate of 56 cents for a single-line haul of 5 miles and 64 cents for a joint-line haul of equal length. The joint-line haul rates continue up to distances not exceeding 70 miles, at which distance the single-line rate is 168 cents and the joint-line rate 176 cents. At 100 miles the rate is 184 cents; at 200 miles it is 232 cents; at 400 it is 288 cents, and at 520, the maximum distance, it is 312 cents.

The scale on ground limestone, based on a minimum 60,000 lb., begins with a rate of 65 cents for a single-line haul of 20 miles or less, with 10 cents added for the joint-line haul. That addition for joint-line haul continues up to 100 miles. At that distance the single-line haul rate is 130 cents and the joint-line rate 135 cents; at 200 miles the rate is 160 cents; at 300 it is 185 cents, and at 400 miles, the maximum distance, it is 210 cents.

Illinois Stone Companies Gain Through New Rate

STONE companies operating in Joliet, Ill., including the National Stone Co., Lincoln Crushed Stone Co. and the Markgraf Stone Co., will have an opportunity of shipping their products into the Chicago territory as a result of a ruling handed down by the Illinois supreme court, holding the rates fixed by the Illinois Commerce Commission as just and reasonable.

Originally the freight rate on stone shipped from Joliet to Chicago was 65 cents a ton for single line hauls and 85 cents for double line hauls. Stone shipped direct from a quarry and delivered by the railroad picking up the product at the shipping point obtained the lower rate.

The commission later reduced the price to 50 cents a ton for single line hauls and 5 cents a ton higher for double line hauls. This made it possible for the local companies to compete with stone companies in the Chicago territory.

An appeal from this order was taken and the circuit court of Cook county held the lower rate was discriminatory and unduly preferential. Stone companies in the Joliet district engaged the law firm of Barr and Barr to fight the case.

In the decision handed down the supreme court held that the circuit court of Cook county had no right to substitute its judgment against that of the Illinois Commerce Commission and that the rates of 50c and 55c were not unjust.—*Joliet (Ill.) News.*

Possibly Inspired, But Interesting

A GOOD DEAL has been said and published at one time and another about the possible and probably exhaustibility of good, available sources of sand and gravel. One who knows actual conditions would concede that in such localities as the metropolitan centers, New York, Philadelphia, Pittsburgh and Buffalo, there is probability of the comparatively early exhaustion of nearby supplies; but who would even guess South Dakota was in this class? The following from the *Chamberlain* (S. D.) *Democrat* may have been inspired by the producers of competitive materials, but it is interesting:

"Clay county's gravel supply is practically exhausted," is the statement of County Highway Superintendent B. J. Skordahl.

Three years at most, according to Mr. Skordahl, will clean up the supply of gravel in Clay county, and then another proposition will be faced to get material for resurfacing roads.

The condition in Clay county may be similar to many other counties in South Dakota. There is no gravel in some localities, and the supply is not great anywhere. If all the gravel is used up on main highways, there will be none left for connections and market roads, for which gravel is very satisfactory, but it is not a success on highways such as the C. B. H., where tourist traffic is very heavy.

Nothing short of paving will do for main highways, and plenty of people today contend that poor roads are the biggest single item of expense today, figured wholly from the standpoint of wear and tear of automobiles. If the use of cars continues another 20 years, paved roads will be general over South Dakota as they are now in eastern states, and South Dakota paving will be much better than that in many states.

We have the best material for paving in our native products of crushed granite and state-made cement. We hope in another five years to see a program of paving worked out in progress of building, with funds available for farm to market roads built of gravel that is still available.

New Idaho Limestone Development

ONE of the major operations of the American Mines Development Co. for the past nine months has been the development of its calcite deposit at Banks, Idaho. It was expected that a new mill and tramway under construction at the Banks property would be completed and in capacity operation by September 1.

The American Mines Development Co. has been built within the last two and one-half years and backed by about 400 Idaho investors residing at Boise, Twin Falls and surrounding towns.

Last year production was started in a

small way by hauling the calcite rock with trucks three and one-half miles from the quarry to a small mill located on the railroad siding at Banks, where it was crushed and ground into calcium carbonate flour, fertilizer and poultry grit and marketed in carload shipments.

It soon became apparent to the management that the demand for such a pure product as they are able to produce was far-reaching and their entire equipment for its manufacture entirely inadequate to meet the demand. Since early spring the company has kept from 30 to 40 men employed building a new mill at Banks and an aerial tramway from the quarry, which will deliver 50 tons of rock per hour to the bins at the mill. The mill is of the roller type and additional mills may be installed as market demands increase.

Recently the company shipped six cars of calcite flour and grit to Seattle, Walla Walla and Portland.

The company is credited with having the distinction of owning one of the largest and purest beds of calcium carbonate (calcite) in the United States. It tests from 97.6 to 99.3% pure calcium carbonate and is free from any harmful mineral, which creates its great demand in the manufacture of all kinds of stock and poultry foods.

When samples of the Banks calcite were placed in the hands of Albers Brothers Milling Co. of Portland and Seattle they immediately sent their expert to examine the deposit to ascertain the quantity that could be supplied them. Satisfied as to the size of the deposit, they entered into a contract with the company for the distribution of their calcite products in California, Oregon and Washington.—*Boise* (Ida.) *News*.

Mississippi Lets State Highway Gravel Contracts

GRAVEL BIDS of 21 contractors were accepted by the Mississippi Highway Commission recently. Chief Engineer Gus Draper said the prices were 5% lower than those offered in July. All regular bids were accepted on unit prices and no fixed amount of tonnage was listed.

Successful contractors are: Missouri Portland Cement Co., Allen Gravel Co., and Memphis Stone and Gravel Co., all of Memphis; Kolola Gravel Co., Columbus Gravel Co., Southern Sand and Gravel Co., New Hope Gravel Co., and Waters and McCray, all of Columbus; New Inland Gravel Co., Concrete Gravel Co., American Stone and Gravel Co., and Forest County Gravel Co., all of Hattiesburg; Greenville Sand and Gravel Co., Greenville; Weston Sand and Gravel Co., Logtown; Gatesville Gravel Co., Gatesville; Richton Investment Co., Richton; Brookhaven Gravel Co., Brookhaven; Amory Sand and Gravel Co., Amory; Lynn Gravel Co., Avalon, and Pearl River Gravel Co., and J. E. Stephenson Sand and Gravel Co., Jackson.

Virginia Marble Deposit to Be Developed

FORMATION of a corporation capitalized at \$250,000 for the purpose of quarrying marble found near Staunton, Va., has been accomplished by a group of Ohio men, of which Steubenville residents are members. W. H. Warner, Cleveland, president of the Warner Collieries Co., which has mines in this district, has been named president of the company. Frank M. Work, Steubenville industrialist, is vice-president. C. L. Williams, Steubenville attorney, is secretary.

Directors of the corporation are: W. H. Warner, Sheriff William J. Yost, C. L. Williams, Gray Silver of Martinsburg, W. Va., H. J. Ealy, Charleston, Meyer Weisenthal and Allen T. Howser, both of Steubenville.

According to Mr. Williams, the quarries will furnish the densest marble in this country, closely approaching the Vermont marble in composition. The government Bureau of Standards, he says, has said that its compressive strength is the highest in the country, and has approved its use for government buildings.

The marble formation was discovered by J. B. Cattrell, Wheeling, who made surveys to find if there were any other outcroppings in Virginia. There are not, it is claimed, and the 1100 acres will yield marble for 500 years, Mr. Williams declares.—*Steubenville* (Ohio) *Herald-Star*.

Cement-Asbestos Shingle Manufacturer in New Consolidation

THE CONTROLLING INTEREST in Eternit, Inc., 9215 Riverview drive, St. Louis, Mo., the largest manufacturer of asbestos-cement products in the country, has been purchased by the Rubberoid Co. of New York, it was announced recently by B. T. Conwell, president of Eternit, Inc.

Mr. Conwell said the deal involved a transfer of stock. He declined to reveal the consideration involved. The Eternit Co. is capitalized at \$1,400,000. The Rubberoid Co., which tentatively began to enter the asbestos-cement shingle line two years ago, is capitalized at \$15,000,000.

In 1913 Mr. Conwell began the production of asbestos shingles, wall tile, pipe and similar products. The company was incorporated under its present name three years ago and became closely associated with the Societe Anonyme Eternit of Belgium, but was not a subsidiary.

Mr. Conwell said the officials of the Rubberoid Co. had announced the association with the Belgian organization would be continued and that the line manufactured here would be extended to other products.

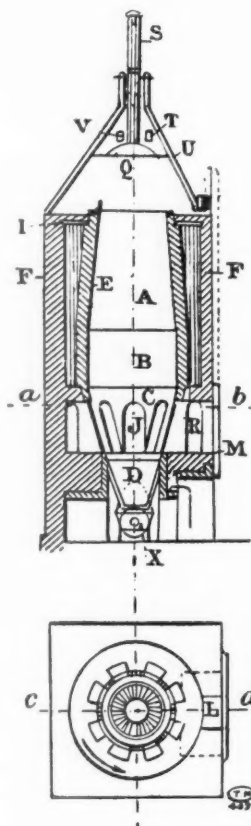
The Eternit Co. holds American rights on exclusive products of the Belgian corporation and valuable patents developed here. Mr. Conwell said he expected to stay in St. Louis in charge of the local plant.—*St. Louis* (Mo.) *Globe-Democrat*.

Foreign Abstracts and Patent Review

Process for Producing Phosphorus and Alumina Cement. Low-priced raw materials such as bauxites lean in silicic acid but rich in iron can be used without having the drawbacks of losses in phosphorus due to the formation of iron phosphide, when first a comparatively easily fusing slag is produced by a reducing fusion of high ferric oxide-bearing bauxites with lime, within the limits of about 70 to 90 parts Al_2O_3 per 20 to 10 parts CaO ; this slag forms very easily and results nearly free of iron, since the iron is eliminated practically completely. This comparatively low-fusing, high alumina-bearing, nearly iron-free slag is used in place of the otherwise customary silicic acid or bauxite as a lime-binding substance in the production of phosphorus from natural phosphorites. In this manner it is possible to obtain in the phosphorus kiln (electric kiln or shaft kiln) a slag clean in silicic acid without suffering losses in phosphorus through iron phosphide, which in the adjustment of the quantity proportions of phosphate and aggregate slag for securing an alumina cement forms a product of exceptional hydraulic properties.—D.R.P. 483,399 of 20.3.27.Cl. 80b, *Tonindustrie-Zeitung* (1929), 53, 98, pp. 1724.

The Effect of Ashes and Flue Dust on Cement. A. Weissmann shows how variations in the amount of ash and flue dust in the finished cement caused probable variations in the quality of cement coming from a wet-process kiln. The flue dust was diverted into the raw mix with good results.—*Tonindustrie-Zeitung* 54, 563 (1930).

Manufacture of Hydraulic Lime. R. Blin describes the process of manufacturing hydraulic limes in detail. The kiln employed in modern practice is shown in Fig. 1. It consists of the three shaft sections A, B and C; the grate D, the lining E, the casing F, the crown I, the discharge J, the throat L, the gate M, the cover Q, the circular frame

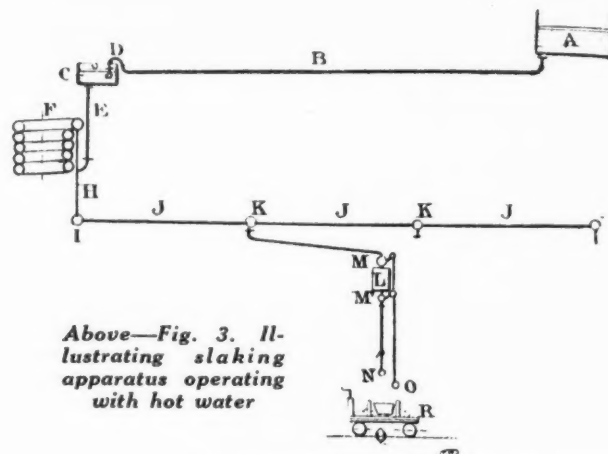


Left—Fig. 1. Kiln employed in modern practice for hydraulic lime manufacture

R, the flue S, the counter weights T and V and the metal frame U.

The slaking apparatus is shown in Fig. 2. It consists of the roller track A, B, the mobile platform C, the winch D, the rail E, the wheelbarrows F, J, the piles of lime G, the ditches H, L.

The slaking apparatus operating with hot water is shown in Fig. 3. It consists of the cold water tank A, the pipe B from A to C, the hot water reservoir C, the float valve D, the pipe E from C to F, the boiler F, the pipe H from F to L, the valves J, K, the slaking pipe J, the gaged reservoir L, the



Above—Fig. 3. Illustrating slaking apparatus operating with hot water

cross-connected valves M, M', the wetting hose N, the lever O of the valves M, M', the tipping truck P, the rolling platform Q, the slaked lime R. The boiler may consist of coils passed around the kiln so that the water is heated by the waste kiln heat.—*Ciment* (1927) 7, pp. 323-329.

Properties and Occurrence of the Cement "Bacillus." Dr. A. Guttmann and Dr. F. Gille report from the Research Institute of the Association of German Iron Portland Cement Plants relative to the properties of the cement "bacillus," and its occurrence in the disintegration of concrete through sulphate solutions. The cement "bacillus" or calcium sulpho-aluminate was given the formula $3CaO \cdot Al_2O_3 \cdot 3CaSO_4 \cdot 30H_2O$ by Michaelis. A number of investigations made since 1892 leave no doubt as to the existence of this compound. But it has been doubted by various authorities that the cement "bacillus" can be found in cement structures which have been destroyed by sulphate.

Therefore the authors report on a few investigations in which without doubt very great quantities of the Michaelis salt have partly been found. First the authors review

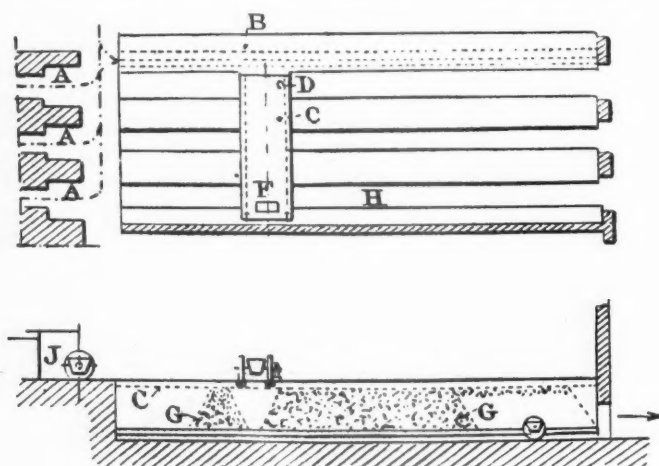
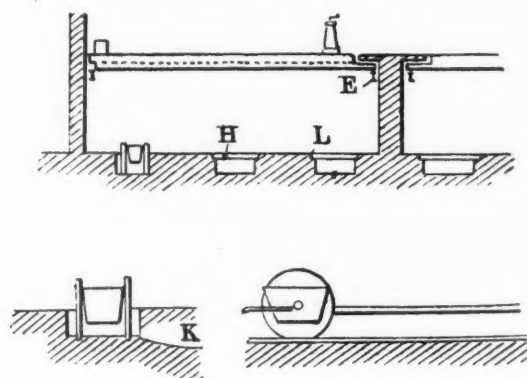


Fig. 2. Showing the slaking apparatus used for the manufacture of hydraulic lime

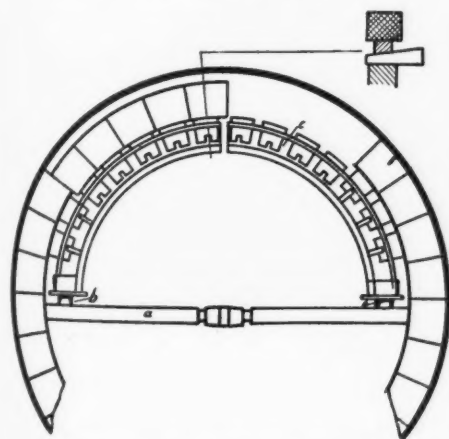


briefly the literature that is of importance relative to the recognition of the cement "bacillus," including also the work of Lerch, Ashton and Bogue (Paper 19 of the Portland Cement Association Fellowship, Washington). Then they describe six different cases of disintegration of concrete and of mortar through sulphates, in which they have determined the cement "bacillus."

As a result of their findings they do not doubt the existence of the Michaelis calcium-sulpho-aluminate in synthetically made products as well as in concrete disintegrated by sulphate. As determined first by them, the Michaelis calcium-sulpho-aluminate is identical with the mineral ettringite and according to dependable analyses of various researchers it has the composition $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 3\text{CaSO}_4 \cdot 31\text{H}_2\text{O}$ (in air-dry state or dried above sulphuric acid); its optical qualities, also first determined correctly by the authors, differed clearly from other known products of hydration.

Besides the cement "bacillus" there exists a salt low in sulphate and water, namely $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{CaSO}_4 \cdot 12\text{H}_2\text{O}$; it is stable only under very definite conditions and therefore is but seldom found in concrete disintegrated through sulphate; the cement "bacillus" forms under normal conditions even from a salt which is low in sulphate, when this salt has been expelled, and therefore the "bacillus" is found frequently in concrete disintegrated through sulphate. The Michaelis calcium-sulpho-aluminate is not stable under the influence of stronger magnesium salt solutions nor of soluble carbonates upon concrete in simultaneous presence of sulphate, nor in solutions which are hotter than 40 deg. C., nor in acids; otherwise it has comparatively high stability. The best protection against an extensive formation of cement "bacillus" in mortar and concrete is assured by use of a dense and rich mixture, which should be given first, as far as possible, sufficient time to harden in the air.—*Tonindustrie-Zeitung* (1930) 54, 46, pp. 759-762.

Scaffold for Lining Rotary Kilns. German patent has been applied for on the "Wedge-Tight" rotary kiln lining. A scaffold is formed of two bars *a*, which can be



"Wedge-Tight" kiln lining scaffold

adjusted by the stretching screws ⁴ and of U-iron *b* placed upon the bars, upon which the frame arch *c* is then installed. The refractory brick are then placed upon the rim of the frame arch and pushed one by one against the kiln wall by means of wedges. After the keystone has been placed, the wedges are loosened and then the scaffolding is moved forward so that the next section of the kiln lining can be built.

Process for Producing Rapid-Hardening Slag Cement. Slag, clinker or other equivalent materials and sulphate of lime (gypsum, anhydrite, karstenite, etc.) are each ground fine separately after a previous suitable drying or dehydration, then cooled to normal temperature and then mixed with each other. The proportion of calcium sulphate is suitably ground considerably finer than the slag. The slag, clinker and anhydrite are then in a proportion of about 80:5:15. Karstenite is used with a maximum content of 5% of water of crystallization, or gypsum with a total maximum water content of 5%. The gypsum is dried and ground step by step until the desired dryness and fineness is reached. The cements harden quite rapidly and have a high strength already from the start of set. Each material is ground separately in order that a simultaneous expulsion of water from the components does not cause setting while still in the mill. German Patent No. 498,202.—*Tonindustrie-Zeitung* (1930) 54, 48, p. 796.

Considerations of the Index of Hydraulicity of Hydraulic Binders. In reviewing the results of his comprehensive theoretical considerations, H. Lafuma states that it is possible under certain reservations to define for the silica-alumina-calcareous binders an index of capability to the hydraulic hardening and an index of chemical resistance, exclusively based upon the chemical composition of the binders.

The relation $\frac{\text{SiO}_2 + 0.2\text{Al}_2\text{O}_3}{\text{CaO}}$ can be selected as the index of capability of the hydraulic hardening of a binder. It permits of classifying the different binders under the relation of hydraulicity.

The relation $\frac{\text{SiO}_2 + \text{Al}_2\text{O}_3}{\text{CaO}}$, proposed wrongly by Vicat as the index of hydraulicity, is in reality an index of chemical resistance.

The difference between these two indexes arises from this: That the hydraulicity of a binder is function of the composition of the anhydride compounds which constitute the binder; whereas the chemical resistance is function of the hydrated compounds which constitute the hardened binders.

It is necessary to take account of this difference in the definition of the two indexes. The author covers all hydraulic binding agents in this original treatment.—*Revue des Matériaux de Construction et de Travaux Publics* (1929) 238, 241-246.

Recent Process Patents

The following brief abstracts are of current process patents issued by the U. S. Patent Office, Washington, D. C. Complete copies may be obtained by sending 10c to the Superintendent of Documents, Government Printing Office, Washington, for each patent desired.

Blasting Method and Tamping Cartridges with Utilization of Liquefied Gases. By this invention the blasting method calls for the interposition of solid tamping over the entire length of the bore hole to provide for a heavier effect at the deepest portion. Intermediate tamping cartridges, made from wood dust and participating in the detonation are claimed to provide a new method whereby different effects can be obtained in the same bore hole with the same kind of cartridge. The intermediate cartridges can be improved for combustion by adding catalyzers such as metals and salts to the extent of 10 to 15% in addition to the wood dust.

These tamping cartridges tend to absorb

Fig. 1.

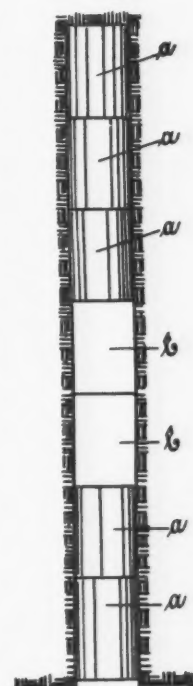
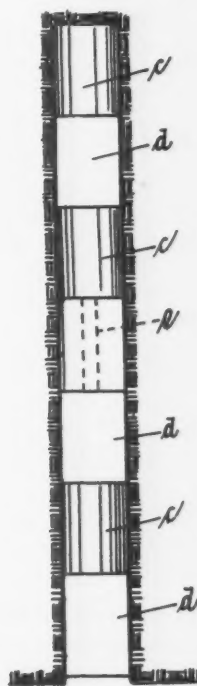


Fig. 2.



Placing intermediate tamping cartridges for blasting

the evaporation products and prevent reducing the temperature of the gases from explosion so that the gas volume depending on the temperature is maintained constantly. Fig. 1 shows a bore hole with three blasting cartridges *a* in the inner end, several intermediate tamping cartridges *b* placed on top of cartridges *a* and two more blasting cartridges *a* above. In Fig. 2 an arrangement is shown whereby the tamping cartridges can be alternated, the intermediate cartridges having a central longitudinal channel *c*. For the intermediate tamping cartridges any oxidizable, organic or inorganic, with or without the addition of a neutral mass may be used.—*Leopold Lisse, of Berlin-Lichterfelde, Germany, United States No. 1,767,181.*

Book Reviews

Thermal Expansion of Cements and Their Mixtures

(Shichiro Uchida. *Memoirs of the Sendai [Japan] Higher Technical School*, Vol. 7, No. 1, December, 1928)

Reviewed by

J. C. PEARSON

Assistant to Chemical Engineer, Lehigh Portland Cement Co.

VOLUME CHANGES in cements, mortars and concretes are so intimately related to the permanency of these materials that any new data on any phase of the subject are bound to attract attention. One of the most recent contributions is this Japanese publication of about 130 pages, made up largely of tables and diagrams which embody the results of a multitude of measurements on the thermal expansion of various kinds of cements and cement mixtures. The greater part of the work is devoted to determination of the coefficients of neat portland cements, portland cements containing various admixtures or substitutions, and a number of high early strength cements. Studies were also made on a series of mortar specimens ranging in proportions of cement to river sand from 1:1 to 1:6.

The author states that his purpose in carrying out the investigation was not only to check the results obtained by other investigators, but also to study the changes brought about by the first heating of the specimens. The behavior of the latter at the beginning of the heat treatment he considers more directly related to fire resistance than the latter changes which occur after the moisture has been expelled by repeated heating and cooling. The measurements were made on small cylindrical specimens 5mm. in diameter and 30 mm. long (0.2 in. x 1.2 in.). These were heated in an electric furnace while being held longitudinally between the ends of two silica tubes in such manner that the differential expansion between the specimen and the silica could be measured by a simple optical arrangement.

In view of the many variables introduced into the tests, such for example as different types of cement, different percentages of mixing water, different ages at test and different heating ranges, only a few of the more outstanding results can be given in this brief review.

When a neat cement specimen is first heated its length increases from room temperature to about 100 deg. C.; further heating to about 600 deg. C. brings about a high shrinkage; thereafter its length increases rapidly to the softening point. Coolborhood of 0.00001 per deg. C.; it increases with the temperature to a value of about 0.000014 at 500 deg. C. and is still higher at

higher temperatures. The author finds "an important difference in the expansion coefficients due to chemical composition" for different cements, but no evidence of any definite relation is shown in the paper—this statement seems to be based merely on the fact that he obtained different values on different cements. He also concluded that the thermal coefficient tends to increase slightly with the age of the specimen, and that variation in percentage of mixing water has only a very slight effect. At the close of his discussion of neat cements the author gives average values of the coefficient as determined by different investigators ranging from 0.0000107 to 0.0000145 (per degree C.) as against his own value of 0.0000112. He points out that this is in close agreement with the commonly accepted value for steel, 0.000011. (These values are of course 1.8 times the coefficients based on 1 deg. F.)

Under the heading of "Mixed Cements," the author discusses the effect of small and large substitutions of diatomaceous earth, silica clay, volcanic ash, limestone dust and granite dust. In regard to diatomaceous earth mixtures one infers that the effect of the first heating is somewhat more serious than in the case of cement alone, although the coefficients decrease generally with increase of earth after the reversible state is reached. The effect of the other substitutions is variable depending upon the quantity, but in general they are not large. In his summary of results the author says, "No admixture has any considerable effect on the thermal expansion of cement."

The experiments on mortars reveal certain differences of behavior as compared with neat cements. Expansion occurs on the first heating only to about 400 deg. C., then a slight contraction with little net change during the next 100 deg., and thereafter a gradually increasing expansion. After a few cycles the heating and cooling curves become reversible. The author states in the text that the effect of the sand in the mortar is positive; that is, the coefficient decreases somewhat with increasing proportions of sand, but the tabulated values do not seem to bear this out. For 1:1 mortar the value given is 0.0000084, somewhat higher values are recorded for 1:2 and 1:3 mortars, the coefficient for 1:4 mortar is given as 0.0000107, and finally 0.0000089 for 1:6 mortar. The discrepancy may be due to the fact that the above values were obtained in the temperature range 50 deg. to 100 deg. C., whereas the author may refer to average values obtained between room temperature and 500 deg. C. At any rate it is impossible to check the author's general statement, and the

above values are the ones repeated in his summary table. His final conclusion is that "no difference is practically observable in the expansion coefficient due to the relative richness in cement of a mixture, at any rate for the range of temperature 50 deg. to 100 deg. C." We are inclined to believe that the author was more interested in determining the expansion coefficient of quartz crystals than of the mortars, for much more space in the text is given to discussion of the former than of the latter.

The final section of the paper discusses the results of measurements made on a number of special and rapid hardening cements. Quite a study was made of "Soliditit," which some of us remember as an Italian product that created some stir in this country a number of years ago. Thermal measurements on this material are recorded in three or four pages of tables; the author found that it had a higher average coefficient than portland cement. Among the other brands studied were two Japanese cements, ciment fondu, Atlas "Lumnite," "Dyckerhoff-Doppel," "Ferrocrete," "Tyssen," "Velo" and Holderbank. As compared with portland, the high alumina cements were found to have considerably lower thermal coefficients, a fact which the author thinks is important in connection with fire-resistance, particularly of reinforced concrete. As for the others, most of them have coefficients of the same order as portland, but vary somewhat therefrom in the various temperatures the concluding portion of the text which contains the coefficients in the temperature ranges 50-100 deg. C., and 400-500 deg. C., as determined by the author for all the materials tested.

Criticism of the paper may be directed mainly against the presentation. An immense amount of detailed data are given in the tables and diagrams without adequate discussion in the text. In many instances the variation in coefficient values from one temperature range to another is such as to give rise to doubt, not only as to the basis of the author's brief general statements in the text, but also as to the degree of accuracy and control in measurement. About 70 pages are devoted to diagrams. Many of these are of the overlapping type and particularly confusing in the absence of cross-section lines and adequate legends. From an American point of view the paper would be far more interesting and readable if a small fraction of the total effort involved in its preparation had been devoted to clarifying the general trend of results by careful arrangement, selection and presentation of the data.

How the Doctor May Increase the Efficiency of the Industrial Safety Program*

By Charles E. Seale, M.D.

Plant Physician, Lone Star Cement Co., Texas, Dallas, Texas

SIGNIFICANT is the fact that the prevention of disease is promoted very largely through the efforts of the medical men, while the idea of preventing accidents came from the laymen and the field of industry itself.

Safety Movement Gathering Momentum

The industrial safety movement was not heralded with pompous verbosity, but as the practice and adoption of safety measures demonstrated their worth the movement gained momentum. Today that industry which has not fallen into line is considered antiquated. The workman himself is "sold" with the idea of working safely; industry is "sold," and frankly the medical man is "sold" completely, whereas in the earlier days he was often only lukewarm or not interested in the movement. The present attitude of the medical fraternity is demonstrated by the active interest which is now taken in industrial medicine and related subjects.

You have listened to the employer's side of the story as well as that of the workman himself, and each gets the idea that he is being benefited, either financially or physically, or both. Here the doctor steps in to find that his income has been increased, and from even a selfish standpoint this movement stands out pre-eminently as one in which we may all unite our efforts and make money for ourselves by so doing.

Doctor Makes His Own Worth

The doctor's role in this great movement may be one of limited activity or one in which he may devote his entire time and energy, according to the standard set forth by the industry and the workmen themselves. In no field of endeavor is the opportunity so ripe as for the wide-awake doctor to give his entire service. The call for his service will come when employers and employees realize that the more complete and thorough the work rendered by the doctor, the more complete and thorough the results of a plant safety campaign will be.

Where the activities of the doctor are limited to merely the care and attention to personal injuries as they arise, he has performed a valuable service, but at an economic loss to the injured and to his employer. Now, if his efforts can be made

to show a credit instead of a debit on the ledger of both employer and employee, he will have contributed a greater service than had he performed the most delicate and intricate surgical operation.

What, then, you ask, may the doctor do



Dr. Charles E. Seale

to increase the efficiency of the safety movement?

Rendering Full Service

The doctor should be rendering a full program of service, including the examination of employees as hired and periodically thereafter, follow-up of cases remaining at home because of sickness, supervision of plant sanitation and working conditions, x-ray work, health education, heating, seating of workers, inspection of employees' cafeterias, and working as a consultant with every activity which concerns the workers' health and efficiency. When this is done the physician becomes one of the most valued safety proponents in the industrial sphere.

That this is not done in every commercial organization and industrial plant in the United States is because this program has not been properly "sold" to them.

It may not be feasible for every small industry with a few employees to adopt this entire program, but, no matter how small, certain activities may be carried

out with reasonable success, and I think it is generally agreed that those plants which have 1000 employees can well afford the whole-time doctor as well as a whole-time nurse, while those plants with fewer laborers must depend on part activity of doctor or doctor and nurse. In those plants which limit doctors' activities to care of injured only and which employ no nurse, the establishment of a social bureau to ascertain the cause of absence from work and labor for the elimination of those causes is recommended.

The Sick Worker Is Inefficient

Industrial leaders were slow to accept the advantages available through the establishment of first-aid rooms and small hospital equipment. They looked at it as just another expense. Gradually, after the benefits began to be apparent, they have been more inclined to try out a more complete program, looking to the industrial nurse and physician to reduce the days lost due to injuries and to improve the health of their employees.

A great light began to dawn. A sick worker is an inefficient worker. A worker under the process of cure was an unproductive worker. Prevention, therefore, was cheaper than cure. In the relatively few years of their existence, medical departments have proved their worth to the great industrial plants of this country and are now considered to be a most essential element in production.

Reducing Sick Lay-offs

The most outstanding result has been the reduction of accident days off for the worker. Previous to the inauguration of the works hospital, improper attention to injuries resulted in a greater number of days off because of accidents. One of the first noticeable benefits was the retention of many workers on their jobs even during the day of the injury. In the more severe injuries the reduction of days off convinced officials that the first-aid hospital was of vital importance to them.

Following these savings to the employer and to the employee, it has been a comparatively easy task to seek a broader scope of activity. In scores of instances industrial physicians have told of improvements in hospital service which have been suggested by the executives even before the industrial physician would have felt safe in asking for those innovations for better service to the workers.

*Paper presented at regional safety meeting of Portland Cement Association at Dallas, Tex., February 4, 1930.

In the United States many industries began their medical examination of applicants before they added the first-aid rooms. There were, however, many industries in which the plant hospital was an essential project before the medical examination was introduced.

One Manufacturer's Experiences

The comment of one of the leading storage battery manufacturers is interesting in this respect: "About the time we realized the hazards of lead in the manufacture of our battery plates we not only decided to institute medical service for our workers but to more carefully look into the conditions of the applicant's health. This examination of the applicant before getting upon our payroll brought to our attention many who would have been unable to withstand the dust of the lead process. We considered it, therefore, a distinct advantage to both the man and ourselves."

In connection with the same phase of employment one of the prominent watch manufacturers added: "We utilize our first-aid room to the limit when we check carefully the sight of the applicant. Many an applicant's sight is impaired sufficiently to reduce his efficiency in our organization, and to place him upon the payroll would in many cases result in a waste of much material. There is another side of this question.

"By knowing the condition of the eyes many valuable workers can be used by giving special attention to the light which they shall work under. Often the addition of a localized light unit will adequately correct the situation. In case we knew nothing of this deficiency in the worker's vision a huge waste would be experienced before we knew it."

Examination Affords Corrective Employment

The institution of medical examination of an applicant does not necessarily mean that he shall be rejected, but that his physical defects may be noted and those corrected which are correctable; and in other cases which cannot be corrected, this man may be placed in a position where his physical handicaps will not create a hazard to himself or his co-worker.

A survey was made embracing 182 concerns with a total of over 220,000 workers of which approximately 60% were women. This number did not include branch plants or such equipment located along the lines of railroads. In many instances such railroads were represented by equipment located at their larger car and locomotive repair shops.

The tabulation includes 32 food plants, 7 automobile plants, 14 electrical concerns, 26 furniture manufacturers and 98 miscellaneous industries. The number providing first-aid rooms, nurse and doctor on call were 21; providing first-aid rooms

with doctor and nurse part time, 93; 52 provided two nurses full time and a doctor part time; 17 provided a doctor full time and two nurses full time. Further, 46 examine all employees; 6 examine all employees periodically; 37 provide dental service for their workers; 6 of the electrical companies check the sight every six months; 2 storage battery companies check the lungs of those working in the lead rooms at least three times each year.

Eliminating the Unfit

The number of periodic examinations outnumbers the examinations of applicants for employment. The entrance examination is being turned to as a means of eliminating the physically unfit from being employed in hazardous tasks. Over 180 concerns claimed that these examinations were the most effective means of reducing accidents and days off sick by workers.

There are a large number of industries subject to industrial hazards, and these entrance examinations are most essential in such industries. Often men physically unable to hold certain jobs are physically fit for other tasks within the organization.

While I cannot speak officially for the industrial concerns represented in this regional safety meeting, I am sure that all are more than willing to co-operate with the workers in developing this safety program to the highest degree of efficiency possible, fully conscious that in so doing each is greatly benefited from an economic standpoint, and the opportunity is extended to do a greater service for humanity.

Lehigh Uses Striking Posters for Emphasizing Safety

"And the end is that the workman shall live to enjoy the fruits of his labor; that his mother shall have the comfort of his arm in her age; that his wife shall not be untimely a widow; that his children shall have a father, and that cripples and helpless wrecks who were once strong men shall not longer be a by-product of industry."

THE ENVIABLE RECORD which has been established by employees of the plants affiliated with the Lehigh Portland Cement Co. can be attributed in a large measure to the effective use which its department of safety and welfare makes of striking posters, prominently displayed throughout the various departments of its comprehensive operations. The sentiment expressed in the quotation above permeates the entire organization, whether the employee be a white-collared man or one in overalls.

Copy for the posters is in simple language, as can be seen from some samples that follow. The home always is a forceful topic for any literature along safety lines and the Lehigh organization makes good use of it. Notice:

Be careful. Don't be reckless. Take care of yourself so that you and the missus can some day buy that little home you've thought about. Lehigh men pride themselves on their ability to be careful at all times.

It is better to be careful a thousand times than to be killed once.

* * *

Look into your future. Some day you'll buy a home of your own.

Be careful now—take care of yourself. Don't take chances that might cost you an arm or a leg. Men who work for Lehigh work for themselves and their happiness. That's why Lehigh mills are safe.

You don't have to believe in Santa Claus to believe in safety first.

Every Lehigh man is careful at all times because he believes that it is better to be careful than to be sorry. Take care of yourself, so you can play "Santa" for the kids on Christmas.

KEEP THIS MILL SAFE.

For these posters, snappy semi-comic illustrations are used with the purpose, probably, of getting under the employee's skin while he is in good humor.

Other samples of large black and white hangers contain texts like this:

Builders and contractors know that Lehigh gives service with every sack of cement we sell. It is up to all of us to keep things running smoothly by being careful to prevent accidents that cause delays and interrupt service.

THAT WORD "SERVICE" DEPENDS ON YOU

* * *

Keep the colors flying. We have a good no-accident record and we want to keep it.

Aviators wear parachutes to save their lives when something goes wrong.

Lehigh cement is a dependable product, depended upon and used by thousands of contractors and builders everywhere.

Be dependable and safe. Eternal vigilance is the price of safety.

The safety committee at this plant is working each day to make this plant safe for all. Help them by stopping horse play and carelessness. Keep runways and yards clean. Use toilets and bath houses, not abuse. Make this the safe, sanitary mill.

Wide Roads, Better Motoring

WAYNE COUNTY, Michigan, which embraces the Detroit area, will have 142 miles of 88-ft. concrete pavements before the end of the year. Through careful planning, early acquisition of rights-of-way and systematic construction, the Detroit region has made itself the best equipped motoring area in the world. This has been done without excessive costs to taxpayers and motorists through judicious financing and expending.

What About Fall Accidents?

By A. J. R. Curtis

ACCIDENTS in cement mills and quarries generally show increases in September and October and then a falling off in November and December. This has been the case in four years out of the last five.

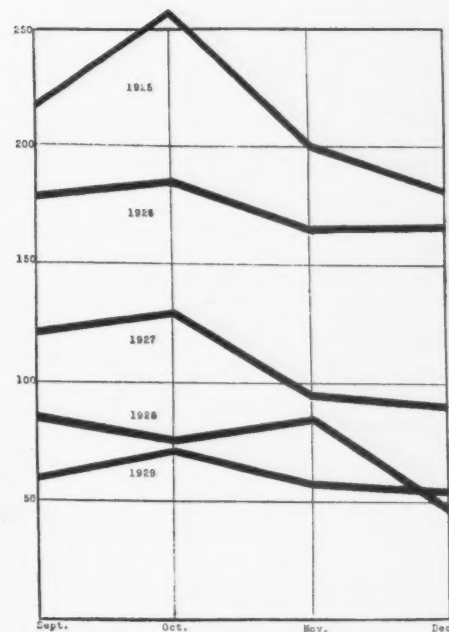
Why should September, with cooler, and usually delightful, weather and more settled and generally satisfactory operating conditions, show an accident frequency rate as high or higher than for August? Why should October climb above September? Are there any good and substantial reasons to justify relatively high accident rates during the last two months of the year, when smaller forces are at work and reduced quantities of cement are manufactured?

The accompanying curves show the trend of accidents during the last four months of each of the past five years. It will be noted that the curves are similar in general characteristics except that for 1928. In the late summer and early fall of 1928 a special effort was made to reduce accidents in September and October and the results were positive and outstanding. A careful study of the entire subject must lead to the conclusion that no sufficient reasons exist for an annual increase in accidents in the fall

and the results of the 1928 campaign offer convincing evidence that by redoubling vigilance, the accident rate during all of the months mentioned can be substantially reduced.

Among the reasons given for an increase in mishaps during September is the reaction after strenuous safety campaigns during spring and summer and reaction after summer heat. On the other hand, however, the cooler weather in September should be conducive to more restful sleep and closer application to duties while at work, while the termination of the vacation season should make for a return to greater regularity in the plant and at home. All of these things are aids to safety and to thoughtful minds, the situation in September seems conducive to safety rather than otherwise.

Personally, I am satisfied that this is the case and that an earnest effort to keep up interest in safety in September will yield returns above those to be expected during the heat of summer. October should be a low accident month for the same reasons which prevail in September, and in addition, the prospective decrease in force with the customary curtailment of operations of a few



Trend of accidents during last four months of the past five years

weeks later should put every man on his toes, as only the best are retained over the slack period.

November and December operations are usually conducted by a picked group selected from the larger force employed during the summer and notwithstanding unquestioned



In this beautiful tropical setting employees and executives of the Cowell Portland Cement Co., Cowell, Calif., rededicated their safety trophy. The celebration was described in our August 16 issue

hazards which appear with the return of cold weather, the slower operating gait should mean less rush and strain and more opportunity for deliberate and consequently safe operation.

With the approach of the season of ice and snow it may be well to express a word of caution against slipping. Men at work in mill and quarry should wear shoes that are watertight, with soles and heels in good condition. Those with defective eyesight should be particularly cautious. There is an element of hazard for many in bifocal glasses.

Dr. Charles E. Dorland

DR. CHARLES E. DORLAND, one of the best known industrial surgeons in Utah and surrounding states, died on August 20 at the Dee hospital in Ogden.

As chief surgeon for the Union Portland Cement Co., Devil's Slide, Utah, and as consultant for a number of mining and rock products industries in the west, Dr. Dorland was well known for his unusual skill in industrial practice. In addition he was the family physician for the entire countryside around Devil's Slide, where he practiced for 23 years.

Dr. Dorland was born in Wisconsin and received his medical education in the medical colleges at Chicago and served his internship there. Discovering a dangerous condition of his health in 1907, he removed to Ogden and shortly after to Devil's Slide. He left a widow, a son and a mother. Funeral services were held August 22 in charge of the Masonic bodies at Ogden, of which Dr. Dorland was a prominent member.

Country Walks Needed

THE appalling growth of fatal accidents and serious injuries inflicted by automobile drivers on pedestrians in rural areas has started agitation for sidewalks along country roads. A survey shows that for the most part states and counties are not empowered to build rural sidewalks. It would seem, then, that local communities themselves must provide for this deficiency.

Universal Atlas Safety Trophy Is Rededicated

THE DULUTH PLANT of the Universal Atlas Co., which is a subsidiary of the United States Steel Corporation, was established in 1916. In 1925 it shared with one Canadian plant the honor of being the first cement mills in North America to complete a year without a lost-time accident. The Portland Cement Association award was won again by the Duluth plant in 1927, and the continuous record which had climbed to 955 days on the date of the celebration of course included the entire year 1929 and landed the trophy for the third time.

The plant's record of but three accidents in 72 months has been achieved under six successive annual plant safety chairmen: W. E. Bellingham, assistant master mechanic, 1925; H. M. Eyer, chief electrician, 1926; A. E. Miller, loading foreman, 1927; F. O. Robinson, general operating foreman, 1928; O. B. Potter, master mechanic, 1929, and Mr. Eyer again, 1930.

Gordon C. Huth, long safety supervisor of the Duluth plant, recently became safety director of the entire Universal Atlas company. He was succeeded in Duluth by A. S. Hetherington, who was arrangements chairman for the celebration on August 20, described in our last issue. The plant has also won the annual safety trophy of the Duluth Chamber of Commerce three times.

Ray S. Huey, plant superintendent, presided. George A. Ricker, manager of the general educational bureau of the Portland Cement Association, made the address of presentation, with response by Fred Robinson, assistant superintendent. Mayor S. F. Snively of Duluth, and R. J. Fisher, president of the advisory public safety committee of the city, also spoke.

H. G. Jacobson of Chicago, former manager of the accident prevention and insurance bureau of the Portland Cement Association, was a visitor, as were C. E. Carlson, new president, and E. H. Dresser, new vice-president, of the Duluth, Missabe & Northern Railway. Home offices of the cement company were represented by Gordon C.

Huth, safety director; W. H. Dutcher, purchasing agent; T. E. O'Connor, treasurer, and C. C. Millikan, from the traffic department. S. V. Saxby, executive secretary of the Duluth Chamber of Commerce, three of the four city commissioners, and almost the entire membership of the chamber of commerce safety bureau attended.

The big feature came when thirty-two Duluth Boy Scouts, each representing a month of the safety record, released the balloons simultaneously, to ride merrily away with a stiff breeze.

Norwegian Cement Trade

NORWAY PRODUCES approximately 2,000,000 bbl. of cement annually, although the actual capacity of the plants is about 30% greater than the quantity produced, according to the report from Consul C. Porter Kuykendall, Oslo. One-half is exported.

It is believed, says our consul, that the Christiania Portland Cementfabrik at Slemmestad, about an hour by boat from Oslo, is the largest in the country. In 1928 there were 1,200,000 bbl. produced there. The state railways, the harbor department and numerous large power plant construction jobs, account for the greater portion of the domestic consumption.

The Dalen Portland Cementfabrik at Brevik has shown a notable increase in production from 400,000 bbl. in 1920 to 882,000, with a reduction of employees of from 450 in 1920 to 225 in 1928, effected through economies introduced in manufacture. The other plant is the Nordland Portland Cementfabrik at Tyssfjord. Consul Kuykendall's report gives no figures on production there.

Three years ago the Dalen company started using paper bags to replace jute bags and barrels and this has resulted in an annual saving of some 4000 standards of staves and 1,500,000 jute bags. The practice has stimulated the Norwegian paper industry inasmuch as kraft paper of local manufacture is used.

Argentina is the best market abroad for Norwegian cement and the South American countries make up the bulk of export trade.



Winning of the Portland Cement Association safety trophy last year by the Universal Atlas Cement Co. plant at Duluth, Minn., for the third time in five years, was celebrated with a rededication program

A Comprehensive Code

Texas Sand and Gravel Producers' Association Really Goes Into Tender Details — and Dodges No Issues

THE FOLLOWING CODE of business practice, recently adopted by the Texas Sand and Gravel Producers' Association, should be read by aggregate producers everywhere. It is comprehensive enough to serve as a guide of business morality, whether subscribed to formally or not:

Foreword

A written code helps men to think clearly and correctly and to act honorably. It enables the man to measure his business actions by a code of correct standards. It aids the employer in familiarizing his employees with the correct standards to be observed in business. It serves as a gage by which the public can determine the correct standard of each business. Success in any branch of industry is the sum of success of those engaged in that industry. Full individual success is obtainable only by good-fellowship and co-operation between all concerned. In turn, fellowship and co-operation are only possible when there is chance to trade on equality of opportunity; which, again, is only possible when the industry adopts a standard of business practice. This code is not intended to cover every possible or even probable contingency, but rather to form a general basis of guidance for those engaged in the sand and gravel industry of Texas. It is submitted with the idea that, if followed out, it will encourage good feeling among those engaged in that industry and assist in placing it on a higher plane in public opinion.

Standards of Correct Practice

The correct rules and standards of practice by which the members of this association shall be governed in their relation with the public, their customers and the members of this association, are as follows:

Relation to the Public

1. All services undertaken shall be so creditably performed that membership in this association shall signify the highest and best there is in business skill and ability.
2. Each member shall endeavor to assist the public by giving all information in regard to quality of product sold and manner of delivery, which is consistent with the interest of the association.
3. It is unbusinesslike and unethical to give any officer or purchasing agent of any kind or character, any rebate in connection with goods sold county, state or other organization which the officer or purchasing agent may be serving.

1. The practice of billing goods at a cer-

tain price and at a certain commission with refunds to pay thereafter is especially condemned as unethical.

2. The members of this association are of the opinion that the best interests of the association and its members will be subserved by dealing only with firms, corporations or individuals of recognized financial responsibility, and it is the common experience of the members that dealing with the recognized agencies in the regular trade channels there is the least trouble and inconvenience.

Relation to Other Members

1. It is taken for granted that every member of this association will be fair and honorable in his dealings. If, at any time, a complaint should be made by anyone to a member of this association reflecting on the integrity of another member, it shall be the duty of such member to whom complaint has been made to discourage such thoughts in the mind of complainant and endeavor to restore a friendly feeling between the parties so involved.

2. Each member of this association shall endeavor to maintain a friendly relationship with his fellow members such as to enable him to meet with them to discuss frankly the means of furthering their mutual interests and at the same time increase the service to the public.

3. Each member shall take an interest in and assist his fellow members by exchange of information and experience which may be generally helpful to the members and not prejudicial to the interest of the public.

4. Members will encourage any practices that are straightforward and aboveboard, such as:

- a. All quotations based on price per ton f.o.b. cars at plant with freight allowed to destination.
- b. All freight should be paid by purchaser, and in the case of shipment going to prepay points purchaser should post bond or make his own arrangement with the carrier to take care of freight.
- c. Credit Bureau should be notified immediately when an account is closed, and it in turn shall notify all members.
- d. Notes, trade acceptances or other collateral taken in payment for material should be of not less than cash value equal to the amount satisfied by same.
- e. All accounts on contracts, where surety bond is involved, becoming 60 days past due shall be filed with county clerk, and the secretary should be notified of such action.
- f. No producer should knowingly solicit

business after sale is made by a competitor.

5. Members shall discourage any practices that are not straightforward and aboveboard, such as:

- a. Selling one grade and shipping another.
 - b. Giving unreasonable terms or consigning.
 - c. Giving secret rebates or commissions.
 - d. Quoting stock that cannot be delivered within time provided.
 - e. Cubic yard quotations, or any basis other than weight measurement.
 - f. Prepayments of freight to any point.
 - g. Furnishing the use of equipment to contractor, free or otherwise, to aid in the sale of material.
 - h. Sampling or criticising a competitor's material after sale is concluded.
 - i. Supplementing or qualifying the regular form of quotation, verbally or otherwise.
 - j. No member shall sell a purchaser who has been refused credit on open account by another producer until such time as the purchaser has taken care of account due member of this association.
 - k. Taking notes, trade acceptances, not cashable without recourse, to satisfy an account, is bad trade practice.
 - l. The selling of goods below cost, with the intent and with the effect of injuring a competitor, and where the effect may be to substantially lessen competition or tend to create a monopoly or to unreasonably restrain trade, is a condemned practice.
6. No executives or owners will directly or indirectly offer employment to any employee of another sand and gravel firm. This shall not be construed so as to prohibit negotiations with anyone who of his own initiative, or in response to public advertisement, shall apply for employment. Hiring employees away from a competitor, or inducing them to leave by other means, is considered unethical.

Conclusion

An adequate code is the greatest blessing that can come to any business. When that business says, "These are our standards and we are willing to be judged by them," there is developed a business consciousness and responsibility which far exceeds that which can be accomplished in any other way.

Each member should secure a copy of the code of this association, examine it critically, and test its completeness, construction and methods of statements. He should communicate with officers of his association the result of his examination, and suggest to them that it be amended in any parts in which he thinks it is inadequate.

Sand-Lime Brick Production and Shipments in August

THE following data are compiled from reports received direct from 21 producers of sand-lime brick located in various parts of the United States and Canada. The number of plants reporting is two more than those furnishing statistics for the July estimate, published in the August 16 issue. The statistics below may be regarded as representative of the entire industry in the United States and Canada.

Reports received from the various plants for the month of August indicate that production has decreased somewhat, as shown by the figures below. One plant reported no production at all. Rail and truck shipments likewise decreased slightly, although the figures show an increase in stocks on hand. A decrease in unfilled orders is also indicated.

The following are average prices quoted for sand-lime brick in August:

Average Prices for August

Shipping point	Plant price	Delivered
Atlantic City, N. J.	\$12.00	\$16.00
Boston, Mass.	10.50	13.50
Dayton, Ohio	12.50	15.00
Detroit, Mich.	12.00@13.00	15.50
Detroit, Mich.	13.00	14.50
Grand Rapids, Mich.		14.00
Iona, N. J.	11.00	14.50
Jackson, Mich.	13.00	
Menominee, Mich.	11.00	13.50
Milwaukee, Wis.	10.50	13.00
Minneapolis, Minn.		10.00
Mishawaka, Ind.	11.00	
Pontiac, Mich.		13.00
Saginaw, Mich.	12.00	
Syracuse, N. Y.	18.00	20.00
Toronto, Can.	11.00	13.00
Winchester, Mass.		14.50

The following statistics are compiled from data received direct from 21 producers of sand-lime brick in the United States and Canada:

Statistics for July and August

	*July	†August
Production	10,414,915	9,635,660
Shipments (rail)	3,101,586	2,920,573
Shipments (truck)	6,780,737	6,436,615
Stocks	14,328,287	15,495,599
Unfilled orders	9,796,500	7,761,500

*Nineteen plants reporting; incomplete, one plant not reporting stocks on hand. Five not reporting unfilled orders. One plant reports "shut down."

†Twenty-one plants reporting. Incomplete, eight plants not reporting unfilled orders.

Building Supply Dealers Dissatisfied with South Carolina Cement Contracts

THE BULLETIN of the Carolinas Retail Lumber and Building Supply Dealers' Association, issued recently, said an investigating committee representing building supply dealers of the Carolinas, had discovered the South Carolina highway commission, purchasing 1,000,000 bbl. of cement, paid 20 cents a barrel less than the price charged dealers.

The bulletin said the Federal Trade Commission, acting under the powers vested in

it by the Clayton act, had started an investigation of the transaction.

The purchase of cement was made in connection with South Carolina's \$65,000,000 highway bond program, the report said.

A committee went to Columbia, August 11, for study of records in the matter of bids for supplying the cement, the bulletin said. Its report charged that "cement was in effect contracted for at 20 cents per barrel less than dealer prices," that "diversion privileges were understood to be an integral part of the contracts," and that "other considerations not customarily accorded dealers were written into some of the contracts."

New York Crushed Stone Producers Approve New State Bonding Law

THE NEW YORK STATE CRUSHED STONE ASSOCIATION turned out almost to a man at the joint legislative committee hearing at Albany on August 21 to register their unqualified approval of a proposed bonding law for labor and materials on public contracts.

The meeting, called by Senator Fearon of Syracuse, chairman of the committee, was held in the Senate chambers of the State Capitol. Its purpose was to obtain the sentiment of the various industries in regard to the new changes in the state lien law. Senator Fearon spoke briefly of the revisions of the law becoming effective October 1 of this year, which his committee assumed had been beneficial, and requested frank statements as to their application and whether any further improvements could be made.

The New York State Crushed Stone Association, having registered their preference for a materials bonding law, came to the meeting with a representation covering approximately 90% of the crushed stone produced in the state. Together with a large number in attendance as representative of other industries, the chamber was well filled and the hearing proved to be an interesting one, lasting into the afternoon.

Royal K. Fuller, ex-secretary of the state highway department, and now engaged in the bonding business under the firm name of Fuller and O'Brien, acted as chairman of those in favor of a bonding law. After a brief resumé of the subject he called upon representatives of the various industries present to address the committee. The first speaker, President Odenbach of the Crushed Stone Association, then explained that the crushed-stone producers of New York state favored a bonding law on materials over anything else, and cited certain cases wherein such producers would have been saved losses had such a law been in effect. He stated that the industry represented an investment of well over \$100,000,000 and believed that the great state of New York did not desire that any materials man should lose money on a public contract.

Mr. Odenbach was followed by George E.

Schaefer of Rochester, Secretary A. S. Owens of Utica, and A. G. Seitz and F. C. Owens of Syracuse, all of whom registered their approval of a bonding law on materials. An attorney representing the New York Trap Rock Corp. also spoke effectively for his client in favor of such a law. It was brought out that 35 states now protect their industries through various types of bonding laws and that shippers to states other than New York, which have such statutes in effect, found that they were materially benefited in a financial way through such protection.

Representatives from the cement industry, the pipe industry, explosives, sand and gravel, bonding and contractors' industries were also present, and a number of these spoke in approval of a proposed law bonding materials and labor. Only the New York State Contractors Association, represented by its attorney, Mr. Andros, and its secretary, Mr. Hayes, argued in opposition.

One of the important features of the meeting was the statement by an attorney of a building contractor that on subcontracts additional bonds would be required from each subcontractor, the expense of all of which would revert back to the original contractor who received the award, and that it would have a tendency to increase costs to the state far beyond the amount of the premiums for the initial bonds, which, it was estimated, would be in the neighborhood of \$300,000. It was suggested that a bonding law might be framed to cover only highway and sewer contracts and eliminate buildings. Mr. Fuller stressed the fact that delays in completion of contracts through defaults meant a very heavy loss to the people of the state through their inability to use the highways, and that while such losses were intangible, they should nevertheless be given serious consideration. He cited numerous cases of that sort and filed copies of a number of lien dockets to impress the committee with its meaning.

The Empire State Sand and Gravel Association was not represented as an organization. However, a number of stone producers who are also engaged in producing sand and gravel spoke in approval of a proposed bonding law. One of these, A. S. Owens of Utica, whose company operates about seven or eight sand and gravel plants in the state, told that conditions in his organization were similar as to both fine and coarse aggregate and that all materials producers needed better protection to safeguard their interests.

The hearing, one of a number being held throughout the state, was continued the following morning, August 22. One hearing was held recently at Niagara Falls, and it is understood another will be held in the near future at a place and time not yet designated. The labor organizations took no active part in the hearing on the 21st, but it is understood that they also favor a bonding law and that the joint committee may hear them at a later date.

Cement Products

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Trend in Designs on Cement Products

Part IV—The Geometrical Division of Design
Holds Important Place in Cement Decoration

By George Rice
Palo Alto, Calif.

THE GEOMETRICAL division of design for cement ornamentation depends chiefly upon rectangular, triangular, oval, square, elliptical and circular forms which are laid out in straight or irregular lines or at various angles to one another. This division of designs is valuable in any substance like cement, as its decorative embellishments are suggestive of strength and durability.

The units in the geometrical designs may have a stoic appearance and seem deficient in the expression which is so essential in most forms of applied art, but the geometric designs of the present are somewhat different in their structure and coloring effects from those of the past. Contrasts and harmonies in the shapes of the motifs and in the color schemes are just about as common in these designs as in any of designs in which naturalistic or any other type of ornamentation is used. Furthermore, the geometric designs are being selected in regard to their faculty of blending with the decorative schemes of the building, the room, the garden, the store front, the sidewalk or wherever they are used.

Opinions, of course, vary as to the adaptability of designs of any kind on any material, whether it be of a rock product or of a rug manufactured from the soft wool of a lamb. Some of our best workers in cement artistry are convinced that there is a growing tendency toward more quiet and tasteful decorations in the homes of the country and say that this tendency will influence designs in cement products.

We have interviewed a number of capable professional decorators in cement on the subject who have this opinion. They contend also that in all probability the designs will run smaller in size than formerly in order to keep in line with the smaller and in some ways more intricate designs which are coming out in other lines of art. Some artisans refrain from expressing any opinion at all, for as one man put it, "Something may arise overnight to change the entire design and

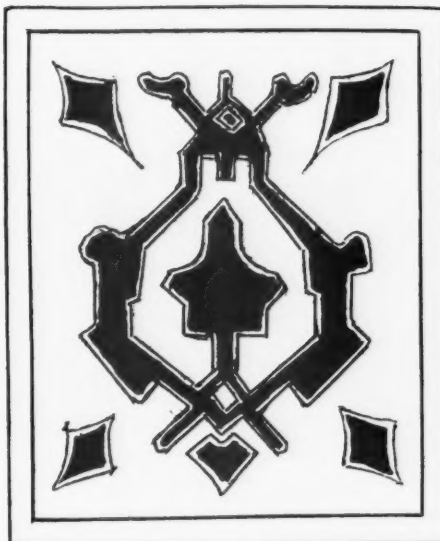


Fig. 1. The geometrical designs on cement are composed mostly of squares, ovals, triangles and circles

color fashions in ceramics so, at best, it is only a guess."

Bizarre Effects Exceeded the Sale of Conventional Designs in One Case

In one instance which came to our observation it was shown that a lot of cement plaques which had been patterned after the order of staid geometric designs did not take

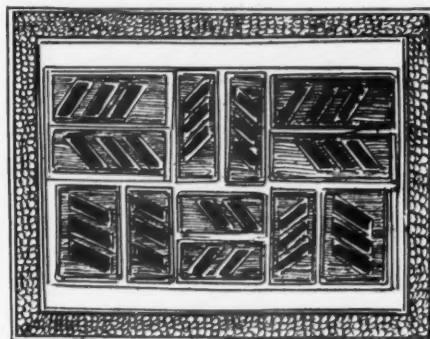


Fig. 2. Some designs are blocked in with regular set motifs

as well with the public as a similar consignment of plaques which were of the bizarre type so far as colors and figures were concerned in their ornamentation. Usually, however, a good design in geometrics will meet with success on cement material if it is properly worked up, whether it is modernistic or old fashioned, or simple or bizarre.

The most brilliant futuristic interpretations on plaques, pottery, tile or any of the cement products will appear flat and uninteresting if they are not properly worked up. One of the most remarkable presentations of worked up applied art was witnessed by the writer in Paris, in 1918, when he was in France with the Eighth Division of the United States army. It was an exhibition of works of art of the inmates of French insane asylums and was held in the Bine gallery. There were paintings on paper and cloth for designs for carpets, furniture, cement tile and vases.

Some of the designs were the work of the mildly insane and others of the inmates who had nearly reached the violent stage. It was noticeable that nearly all these people sought for the bizarre effects in forms and colors. The simple and subdued did not seem to appeal to the erratic wielders of the brushes or crayons. There were morbid sketches and manifestations of mania in many of the creations which these people had made for pastime for the few dollars someone would pay for imaginative or mad art.

One large tile had the form of a planet in its center, surrounded with scrolls and relief effects, and lettered "This is the planet I live on." The mad art drew good audiences of American soldiers, at least, some of whom purchased a specimen to take home.

Geometrical Designs Are Most Easily Made When Squared Drafting Paper Is Used for Outlining the Sketch

Some cement artisans possess the rich gift of free handwork and they can outline geometrical or any other kind of designs

without much effort. Others need mechanical assistance to put on paper correctly an idea which they may have in mind. Squared drafting paper, of about No. 8 size, is handy for this sort of designing. A No. 8 drafting paper will contain 64 small squares in each square inch and is useful for enlarging or reducing the dimensions of a motif when inserting it within the design area.

Fig. 1 is a sketch of a class of designs which can be executed readily with the assistance of ruled drafting paper. If, however, the design is made up with a series of motifs in block form, as shown in Fig. 2, the drafting paper will hardly be necessary, although some artisans use this ready-ruled paper for all occasions.

While high relief is not as popular in geometric designs as it was some years ago, the flat bas-reliefs are still in style. One reason for the falling off of the demand for tile and other cement objects on which high and projecting ornamentation was popular is due to the danger of these extended parts being broken off, leaving a ragged surface to the view. Tile geometrically ornamented is being used to beautify the fronts of garages, entrances of arcades in gardens and front door steps where there is a liability of any high relief parts being knocked off. The designs which are made on the low-relief principle therefore are preferred, because the ornamental parts are more likely to stay.

(To be continued)

Lime and Cement Men Meet with Potato Growers

By Thos. H. Wittkorn
Philadelphia, Penn.

LIME AND CEMENT interests had a good representation and instructive exhibits at the two field days sponsored by the Bucks County (Penn.) Potato Growers Association held at the National Farm School, Doylestown. Five thousand farmers from 16 counties in the southeastern part of the state viewed the exhibits and demonstrations.

These two rock products play an important part in helping the growers get full re-

turn from a crop of spuds after they have been planted and a great deal of interest was shown. Should anyone think that the matter of lime used for spraying potatoes is a trivial thing let him note the fact that Norman Bentz, who covers the central Pennsylvania territory for the American Lime and Stone Co., has sold 20 carloads this year in York county for this purpose.

Scientists from Pennsylvania State College gave demonstrations practically all day in the proper method of slaking lime to secure a spray solution which will not wash off easily when it rains. The college has been giving this subject especial emphasis recently and L. T. Denniston has visited 200 growers' farms this season, in 65 out of the 67 counties of the state, showing them how to mix water and lime for the best results.

The Warner Co., Philadelphia, had an attractive display of its various agricultural lime products and was represented by J. C. Usilton, P. E. Nefflin and F. W. Breinner. The American Lime and Stone Co. was represented by Norman Bentz. N. E. Dietrick, eastern Pennsylvania and New Jersey district sales representative of the Chemical Lime Co., Bellefonte, Penn., had a display and reported spring business very good. E. B. Bower, who covers western Pennsylvania, Ohio and Michigan for the same company, also was there.

The Portland Cement Association, Philadelphia, was represented by J. M. Horner. One of the finest concrete farm storage cellars in eastern Pennsylvania is on the National Farm School grounds, so his story was easily illustrated.

Association Fame Spreads

MILWAUKEE'S concrete products cooperative association received editorial recognition through lengthy stories in English concrete products trade papers recently. The formation of similar protective organizations for mutual benefit among British concrete men is advocated as the result of the excellent work being accomplished by the Wisconsin body for its members.

Ready-Mix a Complex Business

THE SUCCESS of a modern ready-mixed concrete plant involves more than the simple, somewhat haphazard throwing together of cement, aggregates and water. It is a complex activity involving the characteristics of several standard types of industrial effort, according to an unusual story issued in pamphlet form by the J. L. Shiely Co., St. Paul, and written by H. F. Thomson, vice-president of the General Material Co., St. Louis.

"Many Phases Arise in Ready-Mix" is the title of this article. In it Mr. Thomson explains how some idea of the unique character of this new business may be gained by pausing to consider what it attempts to do. It is far from a simple operation. First it produces, at a moment's notice, a perishable product requiring expert and expeditious handling. Each batch is made to order under rigid mechanical control. And the product is delivered immediately anywhere within as wide an area as can be reached at reasonable cost of transportation.

The underlying romance of such a modern institution with respect to readiness-to-serve, promptness, reliability, and withal an improved quality of product, must appeal to the imagination, but awaits a poet's handling for an adequate description. It is a commercial application of the theories of mixing concrete, plus speed and reliability of delivery.

To accomplish such a service necessitates a complex business. To note how complex, can be mentioned the fields into which economists divide business activities.

Thus five separate fields, under one of which most business endeavors may be classified, are all involved jointly in the ready-mixed business, namely, raw material production or commonly called the "extractive" field; the commercial, the manufacturing, the transportation, and the construction fields. Each of these is a component of the ready-mixed business. The two remaining business fields named by economists—the financial and the professional—are not directly parts of the business, though the operator frequently has occasion to serve his customers both as banker and as engineer.

New Jersey Lets Contract for "World's Widest Road"

CONTRACTS for the paving of "the widest improved road in the world" have just been awarded by the New Jersey Highway Commission. The contracts call for the construction of nine-tenths of a mile of a roadway 350 ft. wide with accommodations for 35 lanes of traffic, according to announcement by the commission.

The roadway is the approach to the new Hudson river bridge plaza and the cost of construction is to be \$1,547,418. The contract was awarded to George M. Brewster and Son, Inc., of Bogota, N. J.



How Portland Cement Association missionaries bring their message to the farmer

Pertinent Paragraphs



Interesting items from everywhere condensed and "abstracted" for the benefit of busy readers

By Hugh Sharp

A SUMMARY of the census of manufacturers taken by the United States Department of Commerce in 1927 and compiled by Edward R. Dewey, chief, industrial goods section, brings a wealth of data. This census was authorized for the years 1921, 1923, 1925, 1927 and every 10th year thereafter. The 1927 census summary lists 161 cement plants with 36,322 employees, 2330 concrete products establishments with 17,808 workers, 260 lime plants with 10,903 employees and 45 sand-lime brick plants with 790 employees. Cement ranks 48th in the list of industries with products valued at \$100,000,000 to \$500,000,000 and the summary sets the valuation of cement output at \$293,565,000.

SEVERAL ISSUES ago we told how an English quarry contracted for the front cover of a London trade paper for the purpose of proclaiming the receipt of an order for 450,000 tons of crushed stone. We reproduce another interesting trade paper advertisement by this same British Quarrying Co., Ltd. It serves to give our readers some idea of the size of the concern as is indicated in the list of affiliated companies, printed in the left hand column. English products have, probably to some of us, rather unusual names. The second item is readily recognized. It doesn't require any great stretch of imagination to figure out what the rest of them are. The determined looking gentleman in the upper left hand corner we take to be old John Bull himself. His label is familiar to subscribers of English papers who have occasion to see "Entirely British" flashed forth with admirable persistency. Incidentally, American advertising men can learn a few things in art and color from their brethren on the tight little isle across the sea. Even our own "Sully" admits this ad is a classy layout. The center panel is a chocolate brown color and orange is used for striking contrast.

MATERIALMEN, builders and investors will profit by the research department which has been instituted by the Philadelphia Building Congress under the direction of Alexander B. Randall. Investigation will be started at once into the economics of the local building situation, both public and private work, and Mr. Randall expects the fullest co-operation of all organizations connected with the Philadelphia material and building industry as well as public officials, city departments and business men generally.

KENTUCKY is putting through a \$15,000,000 bridge building program, bonds for which have already been negotiated. Some 26 new spans in various parts of the state are included in the plans.

ANYONE WHO THINKS an Englishman has no sense of humor should have the privilege of reading the page called "Chippings" in the *Quarry Managers' Journal*, an English rock products trade paper. The recent issue tells of some incidents in connection with a convention and relates how a certain well-known quarryman "seemed to be well back into his old form and with his manganese steel lining fully efficient." And again how another delegate was too modest to come forward and receive his golf tournament prize. After he found that the prize was a tankard* the gentleman bewailed his modest inclinations. He had always ardently wanted a tankard. Mind you, a tankard. Ho, hum.

*Webster: "Tankard—A large drinking vessel, preferably one with a cover." The gent who suggests singing the Maine Stein Song at this point should be 100% shot at any convenient time before sunrise.

ALMOST all of us are familiar with the Bon Ami trademark, the chick that "hasn't scratched yet." The principal ingredient of this popular cleansing powder is feldspar. The Bon Ami Co. lists its goodwill at close to \$3,000,000.

THE LARGEST phosphate plant in Europe, producing 200,000 metric tons for the agricultural interests of the Netherlands, has no rock deposit. All of its raw material is purchased from outside countries. United States, Morocco, Tunis and Algiers sends the rock in sea-going vessels that unload directly into the plant's warehouses, an advantage over German methods where transshipment nearly always is necessary.

TOURIST LENHART, now meandering midst moist mineralogical manifestations near Montreal, sends us a newspaper clipping describing the gallant efforts of a hardy motorist who is attempting to make a Canadian trans-continental trip. Such a thing does not exist up to the present time. Fourteen years ago the British Columbia Automobile Club offered a gold medal to the first motorist to cross Canada without resorting to ferry boats, railroad rights of ways or without leaving Canadian soil. No one has claimed the medal nor has there been any serious effort to contest for it. What a contrast to the 3,016,281 miles of highways within the United States and the ease with which we travel back and forth from the Atlantic to the Pacific or from Duluth to Miami.

OPEN LETTERS From the Editor

Good Roads

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SEPTEMBER

1930

Dyer Company Quarry at Clingan Fires Its Annual Blast

By THOS. H. WITTKORN

AFTER nine months' preparation, the Clingan quarry of the John T. Dyer Co., Birdsboro, Penn., on August 22 successfully fired its annual blast which provides stone for a year's operation. Nineteen holes had been loaded with 51,400 lb. du Pont dynamite of various grades and it loosened approximately 275,000 tons of rock. The loading was 6000 lb. of 90%; 6000 lb. of 75%; 18,450 lb. of 60%; 10,000 lb. of "Gelex," and 10,950 lb. "Extra A."

The 19 holes, varying in depth from 186 to 219 ft., had been drilled by two 30B Armstrong gasoline well drills. They were spaced every 20 ft., 30 ft. from the face of the quarry and some of them had a toe of 45 ft. Six-inch bits were used.

The charge for each hole was carefully figured out, several days before it was loaded, by Levi F. Carson, superintendent of the quarry, and E. T. Wolf, salesman of the du Pont company. The holes with the heavy toe received a good share of the 90% powder.

Twelve men, working in two crews, loaded the 19 holes between 10 a.m. and 6 p.m. o'clock the day before the blast. Each hole was made dry immediately before loading by the use of the ordinary well baler. Gelatin



Levi F. Carson, superintendent of the Clingan quarry, ready to shoot the 51,400-lb. blast



The big blast. Note that crusher house, screens and storage bins over railroad track are all below the level of the public highway which runs between the quarry and the plant

sticks 5x24 in. and weighing 25 lb. each were used. A primer was made of the first one by lowering it with the cord attached, but the rest were dropped.

Some of the holes had no breaks in them while others had two and three. Each hole was tamped with 10 to 20 ft. of stone dust. Some 4500 ft. of Cordeau-Bickford fuse with an electric cap at each end and a No. 3 blasting machine were used to fire the charge.

Quarrymen with 30 or more years experience viewed the result of the blast and pronounced it exceptionally fine in the fragmentation which it made. In less than two hours after it was over the steam shovel

was back in the quarry again loading the new stone for its trip to the crushers.

New English Trades Body

QUARRY OWNERS and distributors of sand, gravel, stone and building materials generally in the London, England, area, have organized a trades association, largely for the purpose of correcting an abuse which developed in the business, that of "short measuring." The London area sells approximately three million cubic yards annually, according to F. Wells, one of the promoters of the new Ballast, Sand and Allied Trades Association.



The face in the Clingan quarry after the blast was fired. Fragmentation was such that the steam shovel resumed loading two hours after the shot

Recent Developments in Synchronous Electric Motors

With Some Remarks on Their Applications and Advantages in the Rock Products Industry

By R. H. Bacon*

IT HAS BEEN but a comparatively short time since the application of synchronous motors was limited largely to high speed drives, where the driven machines were started without load. Later, low speed synchronous motors were used for connection through a suitable clutching mechanism to the load. During the last fifteen years, however, improvements have been effected in the starting and operating characteristics, simplicity and reliability of synchronous motors and the control has been made more simple and flexible. These developments have resulted in broadening the field of application of the synchronous motor until now it is used on many applications in place of the induction motor.

Advantages of synchronous motors at speeds of 600 r.p.m. and above are derived to a great extent from applications requiring one or more of such features as power factor improvements, highest obtainable efficiencies, absolutely constant speed, or operation for long periods at partial loads. Of these, power factor correction is the most common of all reasons for installing high speed synchronous motors. Generally, squirrel-cage motors rated at 250 hp. and smaller at 600 r.p.m. and up, with manually operating starting compensators, are less expensive than unity-power-factor synchronous motors of the same rating, with the necessary direct-current exciters and reduced voltage manual starters. Because of the difference in price of the high-speed motors within these limits the squirrel-cage induction motor may be

chosen to advantage in most instances where power factor correction is not required, especially if a squirrel-cage motor of the highest satisfactory speed is selected, so that it will operate at rated full load.

High-speed induction motors operate at comparatively high efficiencies and power factor when under full load; however, power factors are much lower at low speeds than at high speeds and likewise the efficiencies decrease with the speed ratings. Another factor is that the starting torque of a squirrel-cage motor decreases with the speed ratings. These characteristics of low speed induction motors, and the comparable first cost of synchronous motors in most cases, warrant the use of the latter type for driving direct-connected, low-speed machinery.

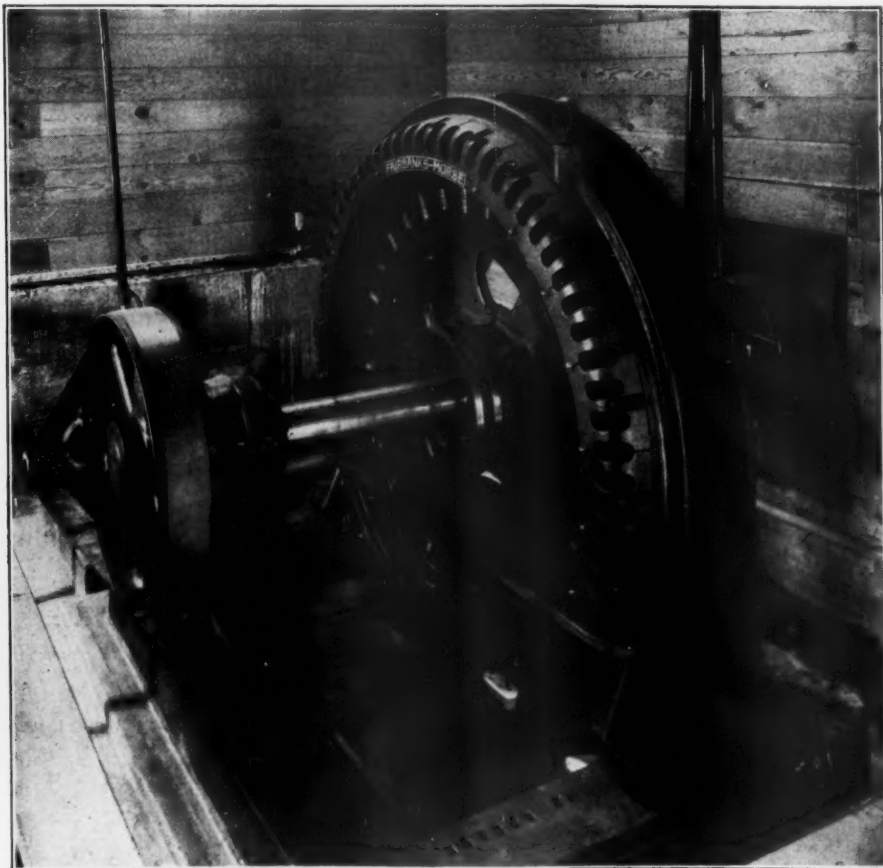
The principal advantages of synchro-

nous motors are, in general, for high-speed applications—power factor correction, higher efficiencies, constant speed irrespective of load conditions and starting torques comparable with squirrel-cage induction motors.

In low speed applications the advantages are: Power factor correction, higher efficiencies and constant speed irrespective of load conditions as in the first group. In addition these motors are available for practically any commercial application and they are recommended for automatic starting by means of inexpensive, simple and reliable across-the-line type, full-voltage, push-button-starter. They are especially adapted for direct connection to the load; require minimum floor space; are comparable in cost with the high-speed induction motor and the required reducing drive for application to low-speed machinery. They are subject to lower maintenance expense than a high-speed motor and the required speed-reducing devices and are less expensive than an induction motor of equal horsepower and speed rating.

Certain inherent characteristics of synchronous motors make possible a most economical and satisfactory design in speeds ranging from 1800 r.p.m. down to 72 r.p.m. Induction motors, however, below 600 r.p.m. suffer a great handicap in performance because of design limitations, and for this reason when driving slow speed machines, high speed motors are used with mechanical speed reducing mechanisms such as belts, chains or gears.

Elimination of all forms of mechanical



Typical example of the advantageous application of the synchronous motor; a 500-hp., 240-r.p.m. unit used for pulp grinding in a paper mill

*Fairbanks, Morse & Co., Chicago, Ill.

speed reducers is constantly sought by operating engineers as the elimination of every possible step in the conversion of power in their plants means the elimination of possible expense and interference with continuous production.

Power losses in mechanical speed-reducing mechanisms vary from 2 to 15% or more of the total power transmitted. Directly coupled synchronous motors avoid these losses.

Maintenance of high power factor results in great economies in the generation, transmission and transformation of electric power as compared to operation with a low, lagging power factor. Induction motors always operate at a lagging power factor, which becomes excessive at speeds below 600 r.p.m. and at part load. Synchronous motors always operate at unity power factor, which is the most efficient power factor for the operation of an electrical power system, or at a leading power factor to compensate for the lagging power factor of induction motors on the system.

Thus the installation of synchronous motors always results in raising the power factor. To the user who buys his power this will likely result in a lower power rate as well as a saving in electric power transmission losses in his plant and the maintenance of a more constant voltage.

Users of electrical energy are interested in power factor correction in so far as it reduces operating costs and provides better service. Increasing the plant power factor may be beneficial in that it may afford an opportunity to add load to lines and transformers which may be fully loaded, without increasing either line or transformer capacity, or it may effect a reduction in load on overload lines and transformers without reducing the connected horsepower load.

Actual current taken from the line by a synchronous motor is either in phase, leading or lagging, depending upon the amount of exciting current supplied to its direct-current field. The power factor may be kept at unity with the current and voltage in phase by proper adjustment of the direct-current field excitation, or by over exciting the field a leading current and power factor may be obtained.

In most commercial applications of synchronous motors, the field current is adjusted for rated load and power factor. If the load decreases under these conditions the motor will operate at a greater leading power factor, giving more than normal power factor correction.

A unity power factor of a rating larger than is necessary to drive its mechanical load will have sufficient stator capacity to operate at some leading power factor; however, an oversize unity power factor motor should not be used for leading power factor operation because of the limitation in capacity of the direct-current field and the lower efficiencies. Instead, a motor should be used with the required horsepower rating necessary to drive the

can be realized with the best induction motors.

The widespread use of synchronous motors in industry dates from the time these motors were provided with squirrel-cage windings in the pole faces for starting, and were thus able to start and accelerate to full speed with at least a part of their full load. Even with the use of a starting winding, early synchronous motors were built from alternator designs to secure manufacturing economies and as a result the advantages of a design for best synchronous motor characteristics were not then realized.

Torques now available in the modern synchronous motors have been largely responsible for a greatly enlarged market for this type of motor.

There are many applications that are now best driven by synchronous motors which were considered totally unsuited only a few years ago. The elimination of the need for clutches and the simplification of control made possible by full voltage starting has done a great deal to popularize the use of synchronous motors.

Closely allied with starting and pull-in torques, in synchronous motor design, is starting kva. This varies from approximately 200% to 250% for motors for low speed compressors and similar applications started on full voltage to several times this amount for applications requiring very high starting and pull-in torques.

Pull-out torque is of importance for loads that vary over a substantial range during normal operation. Full understanding of design factors affecting the pull-out torque of synchronous motors has made possible many successful applications that have heretofore been considered as being totally unsuited for this type of motor.

One of the most recent announcements of an extensive line of synchronous motors that incorporates these operating features is that of Fairbanks, Morse & Co. This organization has broadened its line of synchronous motors to cover a range of ratings from 20 to 10,000 hp. in low and high speed types. These motors have a number of interesting features such as anti-friction bearings and stators with cast semi-steel skeleton frame ends of

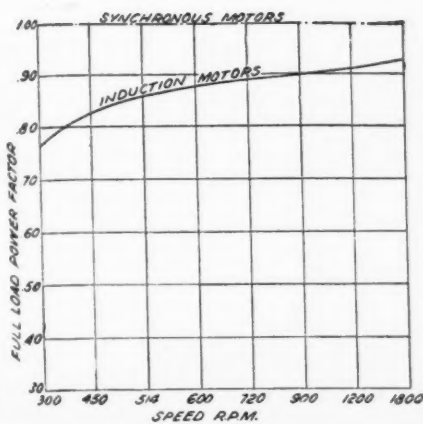


Example of the application of a synchronous motor to an existing compressor in an industrial plant primarily for power factor improvement

mechanical load and at a leading power factor rating to give the required factor improvement.

One desirable feature of the synchronous motor is its inherent tendency to stabilize line voltage. High line voltage causes a decrease in the leading reactive kva. and low voltage within certain limits causes an increase in the leading reactive kva. These characteristics therefore, assist in holding a constant voltage.

Synchronous motors, in their earliest form, were awkward and difficult to control. These objections have been removed, however, and the modern synchronous motor is a rugged machine that can be installed anywhere in the plant, operated by unskilled attendants, and will give the same continuous service, low maintenance expense and long life that

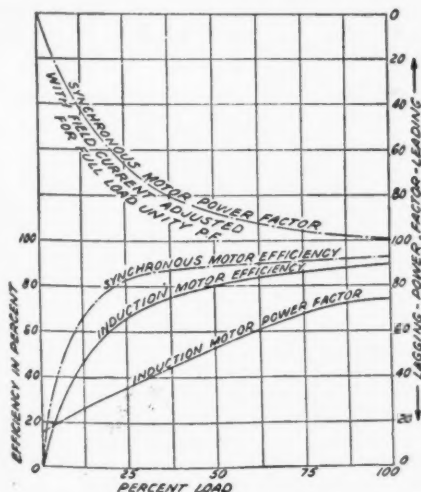


Typical full load power factors of 250-hp. induction and 1.0 p.f. synchronous motors at various speeds

boltless, nutless and threadless construction. Bolts and nuts, when applied to large heavy duty rotating electrical machinery where vibrating problems are encountered, have been supplanted as one of the requirements of better construction.

Stator cores that have come loose because of nuts loosening invariably develop such detrimental characteristics as high core losses and buzzing teeth. These vibrating teeth eventually crystallize and become loose and, as a consequence, often injure the stator coils, resulting in breakdowns and burnt-out windings; furthermore stator laminations that are not cleanly cut or that are cramped in stacking or have too much clearance around the stacking pins or require filing or drifting also result in high core losses and hot spots.

With the Fairbanks-Morse method of construction the entire core is compressed evenly to the desired pressure by means of a powerful hydraulic press. While under this pressure the stacking pins are welded to form a flat countersunk head, which effectively prevents loosening or shifting of the core laminations.



Comparative characteristics of 200-hp., 300-r.p.m., 60 cycle synchronous and induction motors

A liberal use of copper and iron has resulted in a balanced design and better than ordinary efficiencies at not only full, but partial loads. This is a very important feature that is reflected in more economical operating costs of machinery which is in use for long periods of time at either full or part loads.

The type of starter required is simple and requires no skill to operate. It is similar to the across-the-line starter used for small and medium size induction motors but in addition to the main line starter used for small and medium size induction motors, and in addition to the main line magnetically operated line switch and overload relay it has a relay actuated automatic field switch, which closes the field circuit at a predetermined point as the motor approaches synchronous speed. The field switch opens automatically when the motor stops.

These improvements both in the electrical characteristics of the synchronous motor and in the construction features have been carried out by Fairbanks-Morse under the direction of Theodore Schou who is generally considered as one of the foremost designers of electrical machinery, particularly synchronous motors, in this country.

New Standards for Diamond Core Drill Fittings

THE Bureau of Standards has published an illustrated pamphlet describing the new commercial standards for diamond core drill fittings adopted as the result of the bureau's efforts in securing co-operation between manufacturers, drilling contractors and others interested in the subject.

The aim of the new standards is to make diamond core drill fittings, such as bits, casing and rods, as produced by the various manufacturers, interchangeable in the field, in so far as controlling diameters, threads, and dimensions of joints are concerned, and furthermore to provide a convenient series of nesting casings, permitting three reductions in diameter below a 3-in. hole. The benefit to contractors and other users of the equipment is obvious.

To insure that the fittings actually are interchangeable, the manufacturers have adopted a carefully controlled system of gaging, made effective by means of working gages in constant use in the various plants as a guide to satisfactory production.

As a further safeguard to the user and in order that he may know that the fittings he requires conform to the new standards, the working gages can be procured only through the Diamond Core Drill Manufacturers' Association, and the

association has adopted an emblem to be attached to products made in conformity with the new standards, or on packages or cartons containing standard goods. These emblems are supplied only to manufacturers who have purchased the necessary gages for producing the new standard diamond core drill fittings.

The government pamphlet is entitled, "Diamond Core Drill Fittings—Commercial Standard C. S. 17-30" and copies may be procured upon application to the Bureau of Standards at Washington or to C. H. Rohrbach, secretary of the Diamond Core Drill Manufacturers' Association, New York City.

Unique Aerial Tramway Aids in Loading Boats

AT THE QUARRY of the United States Gypsum Co., Alabaster, Mich., on Saginaw Bay, the shallowness of the water makes a loading dock impracticable and the boats are filled from a crib 1¼ miles off shore. The rock is carried to this crib over a cable tramway, the only one of its kind on the Great Lakes, according to George L. Lincoln in a story dealing with modern practice and equipment written for *Engineering and Mining Journal*.

Supporting the tramway are eight steel towers, 60 to 80 ft. high. The towers are on 750-ft. centers. In building them, cribs of 12-in. timbers were sunk in the lake and filled with stone to the water level. On these cribs were placed concrete and stone bases, to which the steelwork, which is of regular tension tower design, was anchored.

The buckets, which are 80 in number and have a capacity of 2 tons each, operate on two cables, from which they are suspended by means of tandem trucks. The cables are anchored at the shore end, and at the other end are provided with weights to regulate the tension.

A 60-hp. motor furnishes power for the tram, driving a large grip sheave, which in turn drives a ¾-in. traction rope of special design. On this rope the loaded buckets are automatically dispatched at a uniform distance apart.

Upon arriving at the loading crib, the buckets are discharged into a large bin by means of trippers which engage latches on the buckets, the empties returning to the shore bin on the continuous traction rope, which passes around a 16-ft. bull sheave at the top of the loading bin. At the shore end the buckets disengage from the cable to a circular track, where they are again loaded and dispatched.

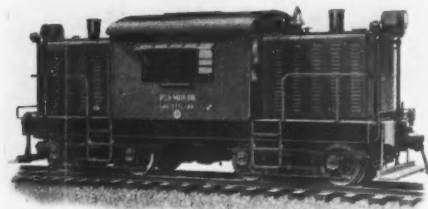
In the boat-loading operation a drag scraper moves the rock from the loading bin. The rock is conveyed up two inclined ramps and discharged into hoppers, each of which feeds a shuttle belt, the belts being on 46-ft. centers.

New Machinery and Equipment

New Gas Electric and Oil Electric Locomotives

THE FATEROOT-HEATH CO., (Plymouth Locomotive Works) Plymouth, Ohio, recently brought out a new line of gas electric and oil electric locomotives in a full range of sizes from 25 to 60 tons. The Model GEL 50-ton gas electric is illustrated.

This model, which is said to be a popular size, is 31 ft. 4 in. long and 9 ft. wide. The frame is built of 15-in. I-beams and 9-in. girder beams, rigidly constructed, with cast-steel bumpers and bolsters. Two 4-wheel,



Gas electric locomotive equipped with 6-cylinder engines

spring-equalized trucks permit the locomotive to negotiate sharp curves and ride rough track with ease, it is claimed.

It is equipped with two 6-cylinder engines, one in each end of locomotive, developing 350 hp. at 1,000 r.p.m.; Westinghouse electrical equipment including two 105-kw. 500-volt, d.c. generators mounted on base with engines; and four 110-hp. motors, two mounted on each truck.

The control of the engines, reversing, acceleration and speed control of the locomotive is accomplished from a single operating station. Westinghouse, 14EL, straight and automatic air brakes are standard equipment.

The locomotive is said to have a tractive force of 33,000 lb. at two miles an hour, and a maximum speed of 36 miles per hour.

Gas-Engine-Driven Welder

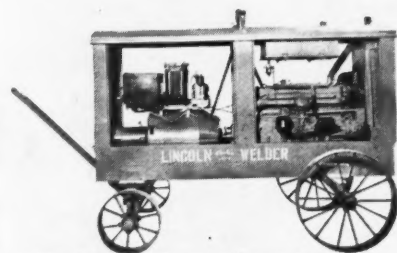
THE GROWING use of larger sized electrodes has led to the development of a new gas-engine-driven welder by the Lincoln Electric Co., Cleveland, Ohio.

This larger machine is designed for field work in all kinds of construction work, and according to the manufacturer's description, is rated at 400 amp. with a current range up to 500 amp., and is of the variable voltage single operator type, operating at 1500 r.p.m. The working mechanism of all controls is

contained in a ventilated enclosed steel cabinet with hand regulators and switches mounted on a panel which forms a side of the cabinet. The control panel contains rheostat, diverter switch, voltmeter and wing nut terminals for cables. This unified control, it is claimed, greatly increases simplicity of operation of the welder. The control cabinet is mounted directly over the generator for easy access by the welding operator. The commutator of both the welding generator and exciter are provided with covers for protection, and the whole equipment is provided with a metal cover with removable metal sides. The sides are interlocking so the cover and sides can all be locked with a padlock and key.

The machine is driven by a six-cylinder engine with an S.A.E. rating of 33.75 hp. and a brake horsepower at 1500 r.p.m. of 55. It is equipped with an automatic throttle control which permits the engine to idle at about half speed when the arc is not going, but when the arc is struck the engine immediately comes up to full speed. Provision is made by a time delay to keep the engine going at full speed when the arc is momentarily broken and will not slow down for a predetermined time interval after breaking the arc, thus permitting the operator to change electrodes, etc., without affecting the speed. The effect of this throttle device, it is claimed, is a saving in upkeep and also in gasoline consumption.

If desired, wheels can be furnished. These



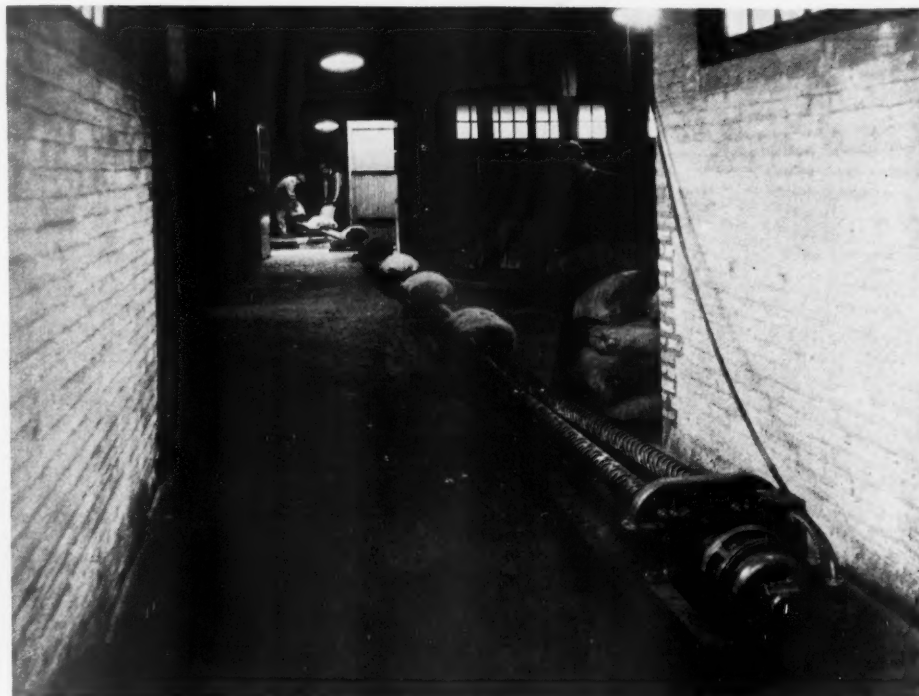
New welder for use in field construction work

are 6 in. wide tread, and a fifth wheel is provided for short turning. Overall dimensions of the machine, exclusive of wheels, are 104 in. x 32 in. x 58 in. and the weight is approximately 3500 lb.

Portable Elevating Conveyor

A NEW PORTABLE, flexible, power-driven elevating and tiering conveyor that should be found useful in conveying, elevating and stacking sacked cement, lime and gypsum has been introduced by the Clark Trutractor Co., Battle Creek, Mich. According to the description, the Clark "Twin-Veyor," as the new conveyor is called, uses a new principle. Two external spiral tubes are turned toward each other by a power head as shown in the accompanying illustration.

A standard unit consists of six 8-ft. dual



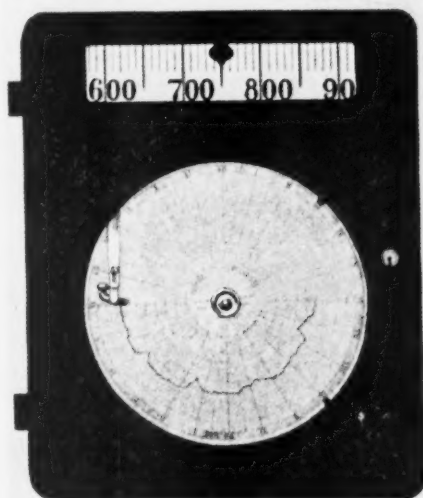
Portable conveyor used for elevating, conveying and stacking sacked cement, lime and gypsum

sections and a power head. Each section, it is claimed, is light, joins to the assembly with an automatic lock, is easily shifted about by one man and the entire 50 ft. line can be assembled or disassembled in six minutes. Flexibility is secured by the ability of any joint to take a 15-deg. angle horizontally; it may be tilted 15 deg. up or 10 deg. down. In the elevating operation, sections may be supported by the material that has already been stacked.

It is said that anything placed on the conveyor travels forward rapidly, perfectly balanced and self-centered—whether it be the handling of raw materials or finished products in bags, bales and bundles.

New Pyrometer Has Many Novel Features

THE UEHLING INSTRUMENT CO., Paterson, N. J., has developed a new pyrometer, designated as the "Self-Contact" potentiometer pyrometer, and designed primarily for measuring high temperatures.



Potentiometer pyrometer for measuring high temperatures

Either a thermo-couple or an electric resistance bulb may be used as the temperature element, and the new pyrometer entirely eliminates the use of depressor bars, cam mechanisms and continuously operating motors. According to the manufacturers, this is made possible by a patented method which assures definite and reliable contact between the needle of a galvanometer and stationary contact pieces without in any way employing auxiliary mechanical devices which, it is claimed, in one way or another conflict with the indicating needle.

This novel contact method permits placing the galvanometer apart and at almost any distance from the recorder, making possible a simple and rugged recorder construction which, it is said, will withstand rough plant conditions and abuses in a way that is impossible when the galvanometer forms part of the recording mechanism. A single gal-

vanometer can actuate as many as four recorders, each recorder in a different location, each measuring a different temperature and, if desired, each having an entirely different calibration.

The entire recording mechanism is fastened to a frame which is hinged to the case, and everything may be opened up to permit accessibility to all parts of the apparatus. A small motor operates only as and when necessary to adjust the pen to the proper temperature reading on a clock-driven chart, and is also in geared connection with two pulleys over which a translucent endless belt, about 2 ft. long, is placed. The belt is calibrated in temperature units and will move in direct proportion to the pen mechanism but at a greater speed, permitting a very open and legible scale which moves in back of a pointer fastened to the door. According to the manufacturer's description, the legibility of the figures, the exceptional length of the scale and the fact that it is illuminated from the rear make it very easily read under all conditions at a distance of 75 ft. or more, and permits placing the recorder where it will most assist the operating staff.

New Weighing Device

THE ERIE STEEL CONSTRUCTION CO., Erie, Penn., announces a new weighing "AggreMeter" with notable improvements as follows:

Gates are of the clamshell type designed to close automatically, and require very little headroom. The gate is opened by turning a crank a quarter of a turn, and when this crank is released it closes itself.

The scale is compact and is of the charging type with a beam for each material or size of material. On the two-compartment bins a two-beam scale is furnished and on the three-compartment bins a three-beam scale. Each scale is equipped with an auxiliary dial which shows only the approach to the desired weight. All knife edges are hardened and ground to reduce wear on these important parts and increase the life of the scale.

A welded-steel material box, which is self-cleaning, is used on this AggreMeter. Excess material can be taken out from this box on all sides. The draw-off doors on the box close automatically, and when closed a positive catch locks the doors, making it impossible to open them until the trip rope is again pulled. Ball-bearing pulleys are used to assure easy and positive action of the counterweight.

This AggreMeter is made in sizes to accommodate 1, 1½, 2 and 3 cu. yd. capacity mixers, and it is shipped completely assembled and

ready to be attached to almost any type bin whether of the company's manufacture or not. When ordered with the Erie Type E, G, or GA bins it comes attached to the bin.

Improved Clamshell Bucket

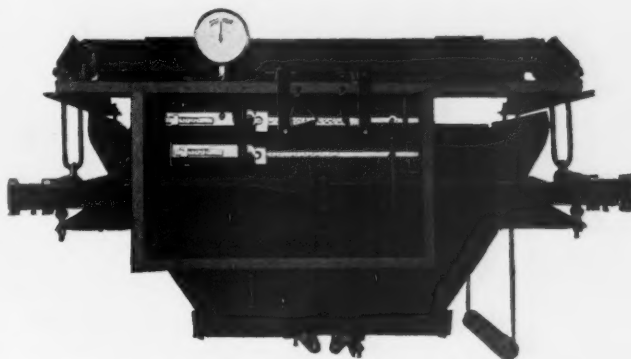
THE G. H. WILLIAMS CO., Erie, Penn., announces an improved "Champion" bucket with new features. The head construction combines the use of cast steel and rolled steel parts, claimed to give greater rigidity and strength to take twisting strains of hard digging. Another feature is a broader and more solid bearing surface for the return sheave pin which, it is



New scoop and other features embodied in new clamshell bucket

claimed, prevents any weaving or wobbling even after years of service. Cast steel brackets, which extend well beyond the backs of the scoops, give added digging leverage and also what is claimed to be a permanently "wobble-proof" connection between scoops and the "A"-frame superstructure.

Other features are a new scoop, designed for easy filling, and all welded so as to be perfectly smooth inside with no obstructions to catch the material, and a one-piece, full-width main hinge to keep the scoops in perfect alignment even after years of service.



Gates of clamshell type close automatically on this new weighing device

News of All the Industry

Incorporations

Mid-Continent Cement Co., Wilmington, Del., 20,000 shares common stock.

Stony Point Sand and Gravel Co., Yonkers, N. Y., \$20,000. A. H. Arnjost, Yonkers.

The Delhi Foundry Sand Co., Cincinnati, Ohio, \$50,000. H. H. McVay, Estelle McVay, L. R. Ginn, Blanche Gravener Ginn and P. L. Strange.

Louis Balduzzi Sons, Huntington, N. Y., \$15,000. F. J. Munder, Huntington. To produce sand and gravel.

Arnold Stone Co., Greensboro, N. C., \$100,000. To produce cast stone and concrete specialties. M. A. Arnold, L. L. Krippner and Mary Albert Arnold, all of Greensboro.

Quarries

The Wallace Stone Co., Bay Port, Mich., has begun shipping of crushed stone by boat. The company reports increasing orders for crushed stone.

Dominion Steel and Coal Corp. is planning extensive development of limestone quarries on the island of Cape Breton, Canada. The deposit is located about seven miles from Sydney and is said to be a continuance of a deposit which runs from the Point Edward limestone quarries at present owned and operated by the corporation.

Sand and Gravel

E. G. Hinkle Sand and Gravel Co., West Monroe, La., has moved into its new building on Trenton St., West Monroe.

Lucasville, Ohio. Receiver has been appointed for the Colegrove Sand and Gravel Co., whose plant is located on the Scioto river near Lucasville. Receiver's bond is fixed at \$1000.

The Holloway Gravel Co., Tangipahoa Parish, La., has filed a petition asking that the Louisiana Sand and Gravel Co., New Orleans, La., be declared bankrupt. The petition alleges that the New Orleans concern owes debts of \$1000 and over, is in an insolvent condition, and the Holloway Gravel Co. is one of the creditors.

The Murphy Sand Co. has taken over the sand and gravel business of William Weidner at Fremont, Neb. Mr. Weidner leased a part of the Nelson estate farm here a couple of years ago, established a gravel pit, and has been doing a large truck business. The Murphy Sand Co. has taken over the lease and will continue the business.

Delhi Foundry Sand Co., Cincinnati, Ohio, incorporation notice of which appears in this issue, is to operate a plant for the production and distribution of foundry sand and other foundry supplies. The present address of the company is care of P. L. Strange and Co., Chamber of Commerce Bldg., Cincinnati.

Arundel Corp., Baltimore, Md., has been awarded contract to dredge 11,930,995 cu. yd. of inter-coastal waterway from Beaufort to the Cape Fear river in North Carolina. The canal to be constructed is to be part of the government's inland waterway project to extend from Norfolk, Va., to Charleston, S. C.

Cement

Volunteer Portland Cement Co., Knoxville, Tenn., is to move its offices from the Holston Bank Bldg. to the new Fidelity-Bankers Trust Bldg. at Gay and Union Sts., Knoxville, where the company will occupy about one-third of the fourth floor space.

James Pettit, an employe of the Pacific Coast Cement Co., Seattle, Wash., was found unconscious and in a critical state as the result of an accident believed to have occurred when he was caught between two freight cars which were being switched. He is now at the Providence Hospital in Seattle.

North American Cement Corp.'s Berkeley (W. Va.) plant recently celebrated its passing through a full year without a lost-time accident to any of its several hundred employes. The company provided a picnic lunch for its employes and their

families and first-aid contests were staged. W. L. Bischoff, state mine inspector, participated in the ceremonies.

Alpha Portland Cement Co.'s Bellevue, Mich., plant has received an order from the state highway department for 5000 bbl. of cement for use on the remaining mile and a half stretch of pavement of M-78 between Bellevue and Charlotte, Mich. The state also has placed an order with the Alpha plant for 11,000 bbl. of cement to be used on the Stony Lake pavement northwest of Battle Creek, Mich. Heretofore state-produced cement had been used for these projects.

Lime

Galbraith and Co., Seattle, Wash., is constructing additional lime putty bins at its plant at 2321 Elliott Ave., Seattle. The bins will cover an area 50x19 ft. and will increase the present capacity of the plant from 1000 cu. yd. to 1250 cu. yd.

Cement Products

Ruberoid Co., Bound Brook, N. J., which manufactures roofing specialties, has arranged for the purchase of controlling interest in Eternit, Inc., St. Louis, Mo. The Eternit company manufactures asbestos-cement shingles, corrugated sheets and kindred building products.

Miscellaneous Rock Products

Diatomite Products, Ltd., Northern Ontario Bldg., Toronto, Can., has started work on the foundations for its plant at Martin's Siding, near Huntsville, Ont., which it is estimated will cost \$60,000. C. L. Wood is engineer in charge.

Obituaries

Charles L. Patterson, vice-president of E. I. du Pont de Nemours and Co., Wilmington, Del., for two decades, passed away recently.

Horace B. Christian, president of the Clinch Mountain Silica Sand Corp., Silica, Va., died August 20. W. S. Forbes, vice-president of the same company, passed away on August 6.

Charles Torrey Willard, president of the Willard Brick Co., New York City, and also president of the Willard Sand and Gravel Co., Farmingdale, Long Island, N. Y., died August 28 at the age of 82.

Fred F. Smith, assistant director of sales of the Explosives Department of the Hercules Powder Co., Wilmington, Del., died Saturday, September 6, as the result of a heart attack after an illness of several days. He was 48 years old.

Personals

G. A. Foshay is the new representative in the Wichita, Kan., territory for the United States Gypsum Co. Mr. Foshay was transferred from Joplin, Mo., and is making his headquarters at 520 South Lorraine Ave., Wichita, Kan.

B. H. MacNeal has been appointed southern district manager of the crane-shovel-dragline division of the Link-Belt Co., Chicago, with headquarters at the company's Birmingham office. He will have charge of the territory between the Mississippi Valley and the East Coast south of and including the states of Tennessee and North Carolina.

George M. Norman, technical director of the Hercules Powder Co., Wilmington, Del., and A. B. Nixon, general manager, cellulose products department, are en route to Europe, where Mr. Norman will attend the International Cellulose Conference at Liege, Belgium, and Mr. Nixon will survey the market for American collodion cotton in Germany and other countries.

Ray P. Tarbell has recently become a member of the firm of Robert E. Kinkead, Inc., consulting welding engineers, Cleveland, Ohio. He was formerly Cleveland district sales manager of the Lincoln Electric Co. Mr. Tarbell is particularly fitted by his past experience for his position with

the Kinkead firm, which specializes in a new division of consulting engineering work, supervising the establishment of welding departments within industrial firms and directing the methods of welding procedure, etc. Mr. Tarbell joined the Lincoln Electric Co. in 1918, was afterward promoted to the sales force, and later made district sales manager.

Manufacturers

Fuller Co., Catasauqua, Penn., has opened an office in Chicago at 1118 Marquette Bldg. Jose M. Alonso is the sales engineer in charge.

The Bailey Meter Co., Cleveland, Ohio, has opened a branch office at 2370 Dahlia Ave., Denver, Colo., with M. E. Reddick as manager in charge.

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., has received a \$20,000,000 order from the Reading railroad for supervisory control and switchboard equipment for seven power sub-stations and 14 intermediate stations to supply current to the electrified zone of the road.

Hercules Motors Corp., Canton, Ohio, has opened an office in New York City at Room 427 Chanin Bldg., 42nd St. and Lexington Ave. C. P. Weekes, Hercules sales representative and manager of the eastern territory, will make the newly established New York office his headquarters.

Union Carbide and Carbon Corp., New York City, has purchased a site at Chattanooga, Tenn., for the erection of two new plants for its subsidiaries, the Prest-O-Lite Co. and the Linde Air Products Co. The cost will total approximately \$500,000.

Foote Bros. Gear and Machine Co., Chicago, Ill., has recently appointed J. L. Hart Machinery Co., South Florida and Eunice Aves., Tampa, Fla., as representative of the company in the state of Florida south of a line drawn east and west across the state from Centralia to Titusville.

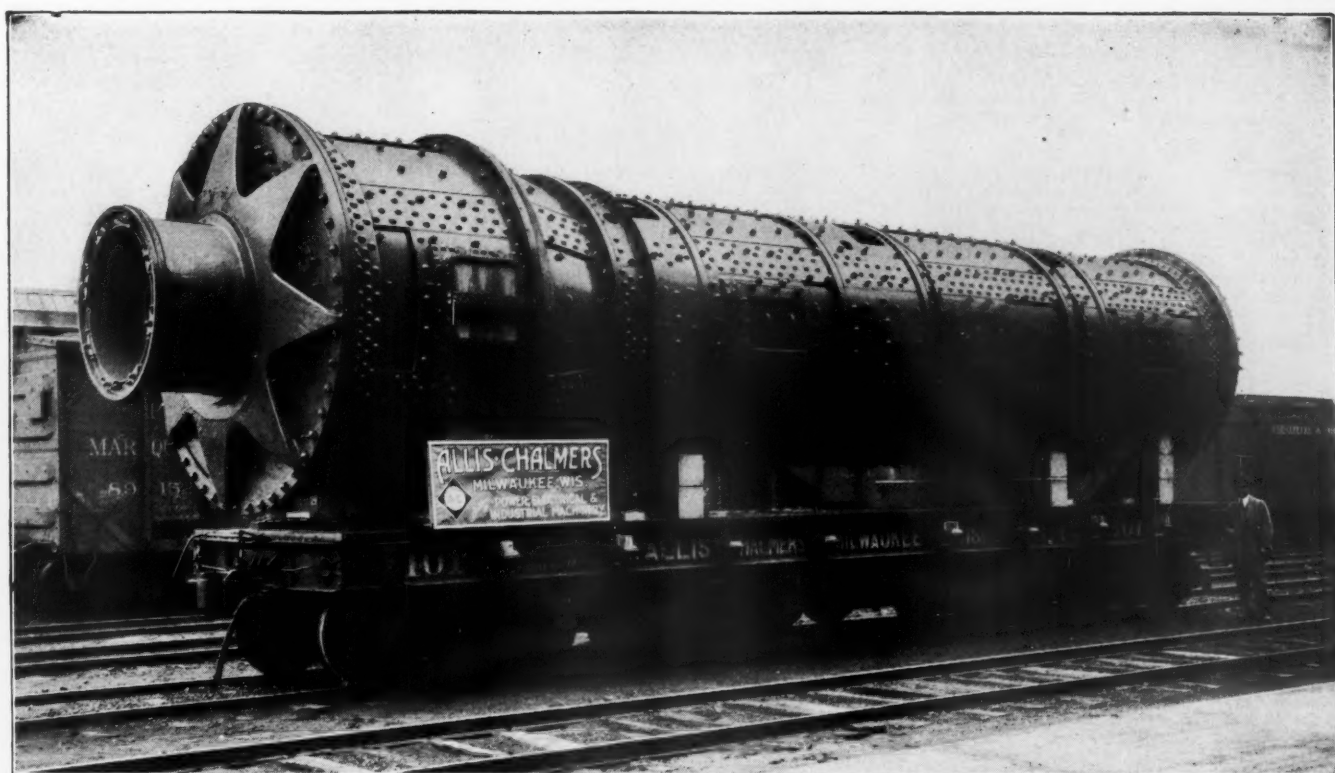
General Electric Co., Schenectady, N. Y., has found a way to encourage interest on the part of its workmen in developing better working methods. During the first six months of this year \$56,974 was paid to employes for suggestions as to how to improve their jobs. For the first half of the present year a total of 17,474 suggestions were made and 5616 adopted, as compared with 13,200 suggestions offered the first six months of 1929 and an adoption of 3953, for which \$49,586 was paid to employes.

Baldwin Locomotive Works, Philadelphia, Penn., at the meeting of the directors held on August 28, increased the board from 15 to 16 members. William L. Austin resigned as a director of the company and also from the board of the Standard Steel Works Co., after having been in the service of the Baldwin Locomotive Works for 60 years. Thomas Newhall and Joseph Wayne, Jr., were elected directors to fill the two vacancies existing on the board. Mr. Newhall also was made chairman of the executive committee.

Burton Explosives, Inc., Cleveland, Ohio, hitherto a sales organization, has entered the explosives and chemical manufacturing field. A plant to employ over 100 men is now under construction on the site of the former American High Explosives Co., near New Castle, Penn. According to J. S. Burton, president and general manager, initial production of 12,000,000 lb. of high explosives in 1931 is projected. Manufacture of a line of heavy chemicals is proposed as a development to follow the establishment of the explosives line. Headquarters of the company are in the Guardian Bldg., Cleveland, Ohio.

Northern Blower Co., Cleveland, Ohio, is expecting a busy season, according to M. A. Eiben of the company, who states that "the keen competition of the past seven months has caused industrial executives to study more carefully than ever the elimination of everything tending to reduce operating and maintenance efficiency." The company is now installing a dust-collecting system for the New Jersey Pulverizing Co., Bayonne, N. J., and one for the Pennsylvania Pulverizing Co. in the grinding and packing department of its Toms River, N. J., plant, as well as one for the J. H. France Refractories Co. at Snowshoe, Penn.

Servicised Products Corp., Chicago, Ill., has opened a large new plant at Wilmington, Del., for the manufacture of many varieties of fibrated asphalt products. Servicised Laboratories, Inc., a Delaware corporation and holding company, owns the new plant. The Servicised Products Corp. of Chicago is the manufacturing concern and will



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Compeb mills, shipped as complete units with all internal parts and both heads in place, are easy to install. Lift them from the cars and place them in the bearings. This greatly simplifies field erection, saving both time and expense.

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operate it. The companies own and operate four other plants in Ohio, Illinois, Louisiana and Florida. Among the products to be manufactured at the new plant are expansion joints, sewer pipe compound, sewer liners, sewer pipe belts, industrial flooring, asphalt fillers, cable trunking and other forms of roofing and asphalt products.

Republic Steel Corp. is to begin work shortly on the \$1,000,000 expansion program for the open-hearth department at the Youngstown works. The work involves the installation of three new 270-ton cranes, said to be the largest ever placed in use in this country. A large addition to the open-hearth building will be constructed. The company has 15 open hearths at the Youngstown works, all but two of which are of 85-ton capacity. The present expansion will increase the thirteen 85-ton furnaces to 110-ton capacity and provide for their later expansion to 250-ton capacity. At Warren, Ohio, the company has announced plans for expansion and improvements involving an outlay of \$1,500,000, exclusive of additions now under way representing an investment of \$1,000,000. Repairs and changes are now being made to the company's blast furnace at this point, and it will be enlarged to 1000 tons daily capacity from 700 tons.

Trade Literature

NOTICE—Any publication mentioned under this heading will be sent free unless otherwise noted, to readers, on request to the firm issuing the publication. When writing for any of the items kindly mention **Rock Products**.

Bronze Valves. Bulletin No. 141 on Jenkins Standard Bronze Valves with the one-piece screw-over bonnet and slip-on disc holder. The valves described are made in globe, angle, cross and check types for all standard service. **JENKINS BROS.**, New York City.

Dryers and Spiral Clarifier. A new bulletin outlining the advantages of Ruggles-Coles dryers and giving a list of the material dried with this dryer. The bulletin also describes the Hardinge spiral clarifier, a simple discharge apparatus which continuously cleans the tank floors and removes the settled solids. **HARDINGE CO.**, York, Penn.

Batch Mixers and Power Skip Loaders. Bulletin describing batch mixers for concrete products plants in all standard capacities—5, 12, 18, 25, 30, 40 and 50 cu. ft. Bulletin also describes power skip loaders for getting material to the mixer. **BESSER MANUFACTURING CO.**, Alpena, Mich.

Air Filters. Bulletin No. 120 giving complete information and engineering data on American air filters for compressors, Diesel engines and gas engines. The adhesive impingement system of air filtration is explained and the various types of filters described in detail and illustrated with photographs. **AMERICAN AIR FILTER CO., INC.**, Louisville, Ky.

Portland Cement. A new bulletin on "Incor" Perfected High-Early-Strength Portland Cement, outlining its advantages and containing a graph which shows the results of tests made in the Lone Star Research Laboratory, New York City, to indicate the relative strength of concrete produced with "Incor." **INTERNATIONAL CEMENT CORP.**, New York City.

Locomotives. Folder describing Whitecomb logging locomotives from 3 to 100 tons. These locomotives are powered with internal combustion engines of high thermal efficiency, are built with the Whitcomb Cross-Equalizer to keep the locomotive in constant rail balance, and have a higher starting tractive effort than a steam locomotive. They are designed to haul capacity loads over rough tracks. **GEO. D. WHITCOMB CO.**, Rochelle, Ill.

Refractories. Bulletin describing various types of Iron-ton fire brick, including "Iron-ton Peerless," recommended for high heat duty service where working temperatures are fairly constant; "Iron-ton Standard" for intermediate heat duty service where temperatures are moderate but where abrasion is severe, and "Iron-ton Nojoint," a highly refractory plastic material recommended for monolithic furnace linings and quick patching. **THE IRON-TON FIRE BRICK CO.**, Iron-ton, Ohio.

Shovels. Additional sheets for the handbook covering the Thew line of power shovels, cranes, draglines and back-diggers have just been issued. These are the first additions to the handbook issued since it was published in 1928, and they cover recent changes in clutch and booster band construction, as well as detailed instructions covering the clutches of the new Lorain-55 and Lorain-45 machines, placed on the market since the book was published. **THE THEW SHOVEL CO.**, Lorain, Ohio.

Cement Testing Apparatus. New booklet giving data on compression tests and their importance in the production of satisfactory concrete, and describing the Fisher compression test machine, a small hydraulic press in which the pressure is generated in the base by means of a ram operated by the handwheel in front. The pressure generated is exerted on a large piston connected to the lower

platen and thus the pressure is applied to the test piece. **FISHER SCIENTIFIC CO.**, Pittsburgh, Penn.

Manganese Steel Parts. A new folder answering many questions regarding manganese steel, its characteristics and suitability for various uses, and illustrating and describing manganese steel parts and castings, including gears and pinions, idlers and traction wheels, screen plates, dredge cutter heads, dippers and dipper fronts, conveyor and transmission chains, hoisting drums, ball mill liners, car and chute liners, dredge and material handling pumps, sheaves, trench machine and ditcher buckets, etc., etc. **AMERICAN MANGANESE STEEL CO.**, Chicago Heights, Ill.

Power Shovels, Cranes and Excavators. A 24-page catalog, **K-3**, containing specifications and data covering the 14½-ton Model **K** (light, ½-yd.) and the 18-ton Model **K-2** (full ½-yd.) Bay City full-revolving, convertible power shovels, cranes and excavators. Illustrations show these machines at work with shovel, clamshell, dragline, trench hoe and skimmer attachments. A second edition of catalog **T6**, covering the company's tractor shovel, is also available for distribution. In addition to the tractor shovel, this catalog contains information on the new **Cranemobile**, a 9¾-ton convertible shovel with crane and four other attachments mounted on heavy solid rubber tires instead of full crawlers for work on hard surface pavements, etc. **BAY CITY SHOVELS, INC.**, Bay City, Mich.

Mineral Resources of Illinois

THE Illinois State Geological Survey at the invitation of the Western Society of Engineers held an interesting series of conferences and lectures on the mineral resources of Illinois September 2 to 12 at the headquarters of the society in the Engineering building, 205 Wacker drive, Chicago.

The scientific data which have been accumulated by the Geological Survey in its activities over the past 25 years were shown in an exhibit which comprised their publications, along with maps, charts and samples showing the distribution, occurrence and characteristics of the various minerals found in the state. This exhibit was open throughout the meetings and was explained in further detail at the conferences and lectures.

The purpose of the meetings and exhibit was to help bring before engineers and others interested the information and data which have been collected and are available in the publications of the Survey. That this information is of interest was evidenced by the number of visitors viewing the exhibit and attending the conferences and lectures.

Afternoon conferences were held on the various mineral resources, including coal, oil and gas, limestone, sand and gravel, clays, fluorspar, silica, etc., and a series of four popular evening lectures were given. These included lectures by Dr. M. M. Leighton, chief of the Illinois Geological Survey, Urbana, Ill., on "What the Paleozoic Submergence Did for Today's Civilization in the Great Mid-West"; by Dr. J. Paul MacClintock, professor of geology, Princeton university, Princeton, N. J., on "Our Inheritances from the Ice Age"; by Dr. Cary Croneis, assistant professor of geology, University of Chicago, on "Earth Movements and the Accumulation of Oil and Gas," and by J. R. Van Pelt, Jr., of the Museum of Science and Industry, Chicago, on "Minerals and Man"; which will be published by the Survey.

The exhibits brought out the fact that for 1928, the latest figures compiled, Illinois

stood first in the production of silica sand with an output of 2,000,000 tons; second in the production of sand and gravel with an output of 19,000,000 tons from 337 plants, and fourth in the production of limestone from 69 plants.

The exhibits were explained and the conferences directed by Dr. M. M. Leighton, chief of the Survey, assisted by J. E. Lamar.

A large amount of interesting and valuable information on the occurrence, availability, production, preparation and use of each of these mineral products is available through the State Geological Survey, Urbana, Ill.

Cement Manufacturers Establish Employment Bureau

DOMESTIC CEMENT MANUFACTURERS on August 26 announced the operation of an employment service to place trained workmen now idle and to retain experienced men in the industry. The Portland Cement Association has established a clearing house through which companies having no places open and those seeking men may co-operate.

This is believed by its sponsors to be the first attempt of a major manufacturing group to co-operate in solving its employment problems and to establish a clearing house for the services of its skilled employees.

The cement industry employs approximately 45,000 workers and is composed of 95 individual companies with 175 mills in 35 states. Most of these companies are members of the Portland Cement Association and are supporting the industry's employment program.

William M. Kinney, general manager of the association, explained that cement companies which have no positions open are referring their applications to the association, which is also notified of openings in other companies.

One Ohio Cement Mill Doing Record Business

CALAMITY-HOWLERS who bemoan the state of business affairs can make no impression upon the morale of the Castalia Portland Cement Co., judging from a statement issued recently by officials of the firm.

Charles Krueger, superintendent of the company, reported that a new all-time record for loading operations had been established during the past month. At that time 123,677 bbl. of cement were loaded. July was also above the average for loading operations with 117,000 bbl. going out of the plant.

The majority of the cement, according to Superintendent Krueger, is going into roads under construction throughout the country. From all indications, September will be another good month.—*Sandusky (Ohio) Register*.